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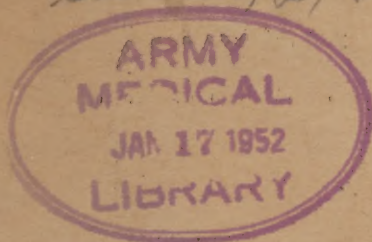
BASIC FIELD MANUAL

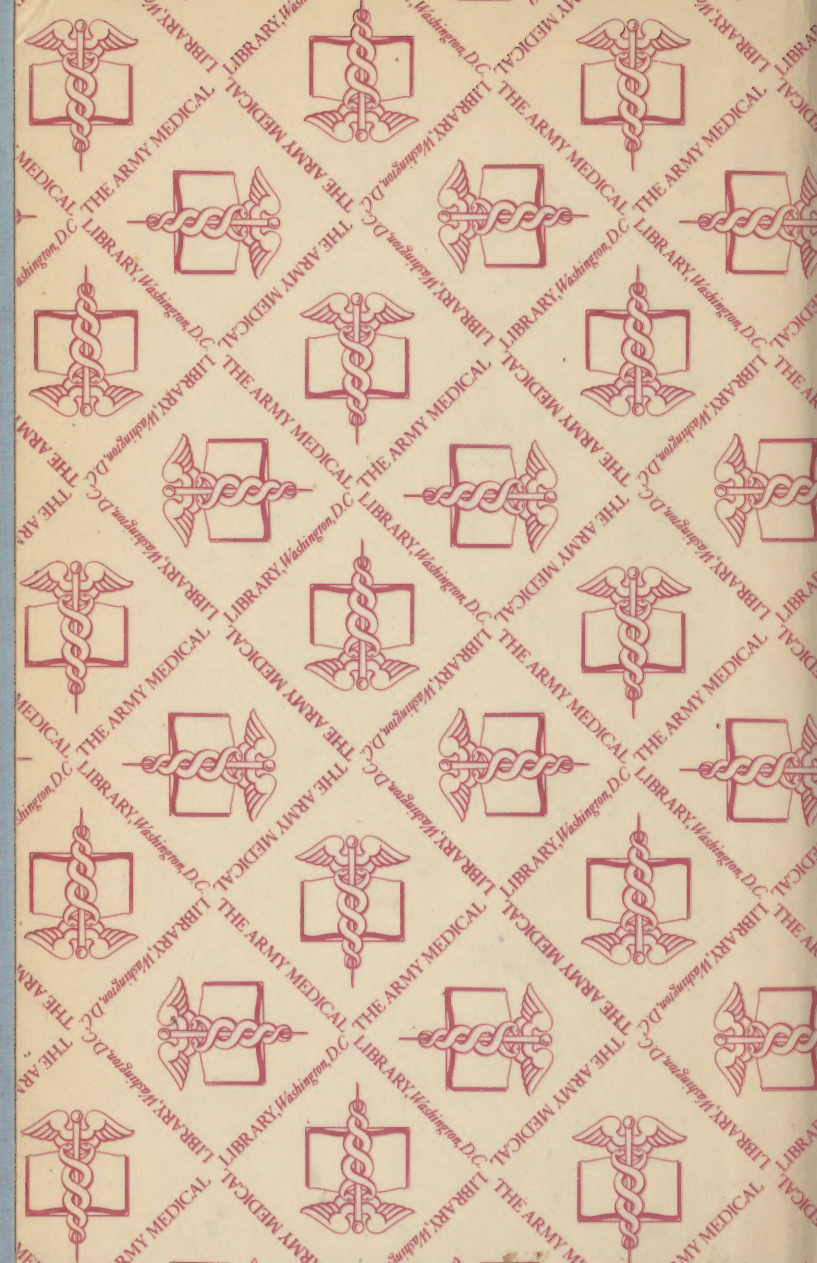


DEFENSE AGAINST CHEMICAL ATTACK

September 7, 1942

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U.S. War Dept

FM 21-40

(BASIC) FIELD MANUAL

DEFENSE AGAINST CHEMICAL ATTACK



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WAR DEPARTMENT,
WASHINGTON, September 7, 1942.

FM 21-40, Basic Field Manual, Defense against Chemical Attack, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

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(For explanation of symbols see FM 21-6.)

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BASIC FIELD MANUAL

DEFENSE AGAINST CHEMICAL ATTACK

(This pamphlet supersedes Basic Field Manual 21-40, May 1, 1940.)

CHAPTER 1

EMPLOYMENT OF CHEMICAL AGENTS

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SECTION I

GENERAL

■ 1. **CHEMICAL ATTACK.**—*a.* Chemical attacks are made with the following objects in view:

- (1) To inflict casualties.
- (2) To deny certain areas to an opposing force through threat of casualties.
- (3) To contaminate matériel and supplies.
- (4) To harass by forcing the opposing troops to mask, thereby reducing their efficiency.
- (5) To affect morale.
- (6) To interfere with observation and aimed fire by use of smoke.
- (7) To destroy matériel and supplies by incendiary action.
- (8) To delay operations.

b. Defense against chemical attack consists of active and passive measures.

(1) *Active measures.*—Active measures consist of all procedures which will impede the enemy in his use of chemicals. An example of such a measure is the bringing of fire power to bear upon enemy gas projecting weapons, and gas ammunition dumps and depots.

(2) *Passive measures.*—Passive measures consist of procedures which will limit the effectiveness of an enemy chemical attack. Such measures include the execution of standing operating procedures in defense against chemical attack (par. 71).

c. The responsibility for the training of troops in defense against chemical attack is a function of command.

■ 2. OBJECT OF INSTRUCTION.—The object of instruction and training in defense against chemical attack is to—

a. Minimize casualties from enemy chemical attacks.

b. Prevent undue interruption to normal military action during combat.

■ 3. SCOPE OF INSTRUCTION.—The scope of instruction includes—

a. A description of chemical agents that may be encountered in the field, their properties, and their physiological effects.

b. Effects of weather and terrain on the use of chemical agents.

c. Methods of dispersing chemical agents.

d. Use and care of protective equipment.

e. Methods of decontaminating equipment and areas.

f. First-aid treatment of gas casualties.

g. Provision and use of protective shelters.

h. Protection of matériel, food, and water.

i. Organization and duties of individuals in defense against chemical attack.

j. Tactical protective measures against chemical attacks.

k. Repair and replacement of supplies.

■ 4. STANDARDS OF PROFICIENCY.—a. *The individual.*—The individual soldier should be proficient in the essentials of defense against chemical attack as given in this manual. An outline of the standards of proficiency in the protection of the individual is given below.

(1) *Chemical agents.*—(a) Ability to identify a chemical agent in the field by odor, color, or physical state.

(b) **Knowledge of—**

1. Persistency of the principal chemical agents.
2. Effect produced on the body by contact with the agent.
3. Protection required against all classes of agents.
4. Methods of decontaminating equipment and areas.

(2) *First-aid treatment of gas casualties.*—(a) Recognition of the effects of agents.

(b) Application of remedial measures pending medical aid.

(3) *Protection.*—(a) *Gas mask.*

1. Proficiency in gas-mask drill.
2. Knowledge of the protection afforded by the gas mask.
3. Knowledge of when to wear and when to remove the gas mask.
4. Ability to take proper care of the gas mask.
5. Ability to perform normal combat duties with minimum decrease in efficiency while wearing the gas mask.

(b) *Protective clothing.*

1. Knowledge of when and how to wear protective clothing.
2. Knowledge of the proper care of protective clothing.

(c) *Miscellaneous protective equipment.*—Knowledge of when and how to apply shoe impregnate and M4 ointment.

(d) *Gasproof shelters.*

1. Knowledge of requirements to make a shelter gasproof; methods of entering and leaving gasproof shelters; method of clearing gas from shelters.
2. Ability to determine the presence of gas in a shelter.

(e) *Protection of animals* (personnel of mounted units).

1. Knowledge of the use of protective equipment for animals.
2. Ability to assist the animal in securing protection.

(f) *Protection of matériel, food, and water.*—Knowledge of protective measures for matériel, food, and water.

(4) *Duties of gas sentries.*—(a) Ability to detect agents in the field by odor, color, or physical state, and the consequent sounding of the gas alarm only when necessary.

(b) Knowledge of weather and terrain conditions favorable for enemy attack with chemical agents.

(c) Ability to recognize sounds indicating the probable installation of weapons and projection of chemical agents by the enemy.

b. The organization.—The proficiency of an organization in defense against chemical attack depends primarily on the proficiency of every member thereof as prescribed in *a* above. In addition, it requires the availability of the prescribed quota of gas officers and gas noncommissioned officers, and the necessary number of trained gas sentries and gas reconnaissance personnel to meet the probable requirements of combat. It also includes the maintenance in serviceable condition of adequate protective clothing, protective equipment, and protective supplies, and the training of the unit as a whole so that it will efficiently take the collective measures and carry out the tactical procedure prescribed herein.

SECTION II

CHEMICAL AGENTS, RECOGNITION, AND FIRST-AID

■ 5. DEFINITIONS.—*a. Chemical agent.*—A chemical agent is a substance useful in war which, after release and acting directly through its chemical properties, is capable of producing a toxic effect, a powerful irritant effect, a screening smoke, or an incendiary action.

b. Concentration.—Concentration refers to the amount of chemical agent present in a unit volume of air. Concentration is usually expressed in ounces of agent per 1,000 cubic feet of air, such a figure being almost identical with concentration expressed in milligrams per liter. Example: 2.5 ounces per 1,000 cubic feet, or 2.5 milligrams per liter. A less common method of expressing concentration is in parts per million. The maximum attainable concentration of an agent at a given temperature is referred to as its *volatility* at that temperature.

c. Persistent agent.—An agent which under average conditions will remain in effective concentration at the point of

dispersion for a period of 10 minutes or more. Some persistent agents last for several days.

d. Nonpersistent agent.—An agent which under average conditions is dissipated from the point of dispersion within 10 minutes.

e. Casualty agent.—An agent of such physical and chemical characteristics that a dangerous or killing concentration may be set up with it under conditions normally encountered in the field. Casualty agents are therefore used directly against personnel.

f. Harassing agent.—An agent used to force masking and thus slow up enemy operations. Only those agents which produce this result with the expenditure of small quantities of ammunition are considered primarily as harassing agents. Lacrimators and irritant smokes are the principal agents of this type.

g. Incendiary.—An agent used primarily for setting fire to matériel. It may produce casualties due to heat burns.

h. Lung irritant.—An agent when breathed causes irritation and inflammation of the bronchial tubes and lungs. Its primary physiological action is limited to the respiratory tract.

i. Vesicant.—A chemical agent readily absorbed both through the exterior and by the interior parts of the human body, resulting in the production of inflammation, blisters, and general destruction of tissue. Vesicant vapors attack the lungs and respiratory tract in much the same manner as lung irritants.

j. Lacrimator.—An agent causing a copious flow of tears, and intense, although temporary, eye pain.

k. Irritant smoke.—Smoke disseminated as extremely small solid or liquid particles in air, causing sneezing, coughing, lacrimation, or headache, followed by nausea and temporary physical disability.

l. Sternutator.—An irritant smoke that causes sneezing.

m. Screening agent.—A substance which when burned, hydrolyzed, or atomized, produces a dense obscuring smoke in air. Screening smokes are used to deny hostile observation and to gain fire superiority.

n. Contamination.—In a military sense, contamination is understood to mean the process of spreading an injurious chemical agent. A person, an object, or terrain may be contaminated.

o. Decontamination.—The process of removing or destroying a contaminating chemical agent upon, or in contact with an object or terrain. Some synonyms for decontamination, each with its own specific shade of meaning, are removal, neutralization, destruction, evaporation, incineration, decomposition, and when applied to mustard gas, demustardization.

p. Interdiction.—To prohibit the use or occupation of an area by the enemy, with the assurance that, should such use or occupation be attempted, enemy troops taking part in the attempt will become casualties, is termed interdiction.

q. Hydrolysis.—The reaction of any chemical substance with water whereby one or more new substances are created. This is a reaction of great importance in chemical warfare inasmuch as many chemical agents are thereby rendered harmless. If the hydrolysis product is of itself a poison, as is the case with all agents containing arsenic, considerable effort is required for neutralization. On the other hand, most screening smokes depend to a considerable extent upon hydrolysis and hydration for their obscuring effect.

■ 6. CLASSIFICATION SYSTEMS.—*a. Physical state.*—Chemical agents may be encountered as gases, liquids, or solids. This classification is based upon their physical condition at ordinary temperatures likely to be encountered in the field.

b. Physiological effect.—Chemical agents affect particular parts of the body in several ways. They are classified for these physiological effects as—

- (1) Lung irritants.
- (2) Vesicants.
- (3) Lacrimators.
- (4) Irritant smokes.
- (5) Incendiaries.
- (6) Systemic poisons.

c. *Tactical use.*—Chemical agents are classified in accordance with their principal tactical use as—

- (1) Casualty agents.
- (2) Harassing agents.
- (3) Screening agents.
- (4) Incendiaries.

d. *Persistency.*—Chemical agents are classified as persistent or nonpersistent.

LUNG IRRITANTS

NAME and SYMBOL	CHLORINE (Cl)	PHOSGENE (CG)	CHLORPICRIN (PS)
Odor	Disagreeable, pungent.	Disagreeable, pungent, like new cut hay or cut corn.	Sweetish, like fly paper.
Color and state in field.	Greenish yellow gas.	First white, changing to colorless gas	Oily liquid changing slowly to colorless gas.
Effects on body	<i>Lung irritant.</i> Causes choking and coughing, smarting of eyes, and discomfort in chest. A 2-minute exposure to an average field concentration produces a casualty. Effects begin immediately.	<i>Lung irritant.</i> Choking, coughing, hurried breathing, pains in chest due to irritation of lower lungs. Approximately nine times more toxic than chlorine; a few breaths in average field concentration produce a casualty. Effects begin immediately but progress slowly.	<i>Lung irritant and lacrimator.</i> Lacrimation, coughing, nausea, vomiting, lung irritation. Approximately one-half as toxic as phosgene.
First-aid treatment	Remove to pure air; keep quiet and warm; loosen clothing; hot drinks of water, coffee, or tea may be given if available; no alcoholic drinks.	Remove to pure air; keep quiet and warm; loosen clothing; hot drinks of water, coffee, or tea may be given if available; no alcoholic drinks.	Remove to pure air; keep quiet and warm; loosen clothing; hot drinks of water, coffee, or tea may be given if available; no alcoholic drinks; do not rub eyes; wipe off splashes of liquid agent on skin.
Persistency	Vaporizes almost immediately under field conditions. Drifts as gas with the wind but being heavier than air clings for some time in trenches, shell holes, woods, and other low or protected places.	Vaporizes almost immediately under field conditions. Gas remains considerable time in low or protected places.	1 to 12 hours.
Action on food and water.	Contaminates. In some cases may be removed by ventilation and	Contaminates. In some cases may be removed by ventilation and	Contaminates. In some cases may be removed by ventilation and

Action on metal	heating but taste remains disagreeable.	heating but taste remains disagreeable.	heating but taste remains disagreeable.
How used	Dry, none; wet, vigorous corrosion. <i>For casualty effects.</i> In cloud gas attacks as substitute for phosgene or mixed with phosgene or chlorpicrin in cylinders or Livens projectors.	Dry, none; wet, vigorous corrosion. <i>For casualty effects.</i> In cloud gas attack from cylinders, projectors, medium artillery, mortars, and aviation bombs.	Slight tarnish only. <i>For harassing and casualty effects.</i> In shell, bombs, or airplane spray; in like manner mixed with CN; in cloud attacks mixed with Cl.
Protection required	Gas mask	Gas mask	Gas mask.

VESICANTS

NAME and SYMBOL	LEWISITE (M1)	MUSTARD (HS)
Odor	Like geraniums, then biting	Like garlic or horseradish.
Color and state in field	Dark brown liquid, changing slowly into a colorless gas.	Dark brown liquid, changing slowly into a colorless gas. Solid below 45° F.
Effects on body	<i>Vesicant, blisters skin.</i> Skin shows slight irritation in 15 minutes followed by grayish discoloration and blisters in 30 minutes to 1 hour. Systemic poisoning; vomiting. If breathed, powerful lung irritant effects within 1/4 hour. If unprotected, immediate irritation of eyes. Approximately six times as toxic as phosgene.	<i>Vesicant, blisters skin.</i> Symptoms delayed 2 to 4 hours. If exposed, eyes burn and inflame. Skin, in contact with gas or liquid, discolors, followed by blisters and sores. If breathed, hoarse cough develops followed by severe pain in chest and inflammation of lungs. Approximately four times as toxic as phosgene.
First-aid treatment	First aid must be prompt to be effective. Remove contaminated clothing; remove liquid agent from skin by daubing with clean cloth; wash with soap and water; flush eyes with water; apply protective ointment according to directions.	First aid must be prompt to be effective. Remove contaminated clothing; remove liquid agent from skin by daubing with clean cloth; apply protective ointment according to directions; wash with soap and water; flush eyes with water.

NAME and SYMBOL	LEWISITE (M1)	MUSTARD (HS)
Persistency.....	Dispersed as liquid which slowly changes to gas. Rate of vaporization depends on temperature, vegetation, and method of dispersion. Rapidly destroyed by water. Summer: 24 hours in open; 2 or 3 days in woods. Winter: 1 week or more.	Dispersed as liquid which slowly changes to gas. Rate of vaporization depends on temperature, vegetation, and method of dispersion. Summer: 4 to 5 days in open; 1 week in woods. Winter: Several weeks.
Action on food and water.	Poisons unprotected food and water. Cannot be made suitable for use.	Renders unprotected food and water unfit for use.
Action on metal.....	Very slight.....	Very slight.
How used.....	For casualty effect or to deny ground through threat of casualties. In artillery shell, mortar shell, airplane bombs, airplane spray, land mines, and by pressure sprinklers.	For casualty effect or to deny ground through threat of casualties. In artillery shell, mortar shell, airplane bombs, airplane spray, land mines, and by pressure sprinklers.
Protection required.....	Gas mask and protective clothing.....	Gas mask and protective clothing.

SYSTEMIC POISONS

NAME and SYMBOL	HYDROCYANIC ACID	ARSINE
Odor.....	Bitter almonds.....	Garlic.
Color and state in field.....	Colorless gas.....	Colorless gas.
Effects on body.....	Dizziness, headache, irregular pulse rate, coma, convulsions, death.	Lassitude, headache, uneasiness, chills, nausea, and vomiting.
First aid.....	Remove to pure air; artificial respiration until arrival of medical aid.	Remove to pure air; to be evacuated as a litter case.

Persistency.....	Nonpersistent.....	Nonpersistent.
Action on food and water.....	Contaminates.....	Poisons—cannot be rendered edible.
Action on metals.....	Tarnishes slightly.....	Tarnishes slightly.
How used.....	For casualty effect.....	For casualty effect.
Protection required.....	Gas mask with service canister.....	Gas mask with service canister.

LACRIMATORS

NAME and SYMBOL	CHLORACETO-PHENONE (CN)	TEAR GAS SOLUTION (CNS)	TEAR GAS SOLUTION (CNB)	BROMBENZYL-CYANIDE (CA)
Odor.....	Like apple blossoms.....	Like fly paper.....	Like benzene.....	Like sour fruit.
Color and state in field.....	Bluish gray smoke from burning type munition; colorless from shell.	A colorless liquid, changing to colorless gas.	A colorless liquid, changing to colorless gas.	Dark brown liquid, changing to colorless gas.
Effects on body.....	Piercing irritation of eyes causing profuse tears.	Piercing irritation of the eyes, profuse tears, followed by nausea and vomiting.	Eye and slight skin irritation.	Severe lacrimation and nose irritation.
First-aid treatment.....	Remove to pure air; face into wind; do not rub eyes.	Remove to pure air; keep quiet and warm; loosen clothing; hot drinks of water, coffee, or tea, if available; no alcoholic drinks; do not rub eyes; wipe off splashes of liquid from skin.	Remove to pure air; face into wind; do not rub eyes.	Remove to pure air; face into wind; do not rub eyes.

NAME and SYMBOL	CHLORACETO- PHENONE (CN)	TEAR GAS SOLUTION (CNS)	TEAR GAS SOLUTION (CNB)	BROMBENZYL- CYANIDE (CA)
Persistence	Cloud from burning mixture drifts with wind. Will remain in low and protected places for some time. Solid CN may remain several weeks. Gives unprotected food disagreeable odor and taste.	Summer: 1 hour in open; 2 hours in woods. Winter: 6 hours in open; 1 week in woods. Dispersed as liquid which changes to gas. Contaminates. In some cases may be removed by ventilation and heating. Tarnishes steel slightly	Not determined	Three days in open; 7 days in woods.
Action on food and water			Contaminates. In some cases may be removed by ventilation and heating.	Contaminates.
Action on metals	Tarnishes steel slightly	Tarnishes steel slightly	Tarnishes steel slightly	Very corrosive to iron and steel.
How used	For harassing effect. In grenades.	For harassing effect. In artillery shell, mortar shell, airplane bombs, and airplane spray.	For harassing effect. In artillery shell, mortar shell, airplane bombs, and airplane spray.	For harassing effect. Artillery and mortar shell; airplane spray and bombs.
Protection required	Gas mask	Gas mask	Gas mask	Gas mask.

IRRITANT SMOKES

NAME and SYMBOL	ADAMSITE (DM)	SNEEZE GAS (DA)
Odor.....	Not definite, slightly like coal smoke.	No detectable odor.
Color and state in field.....	A yellowish smoke cloud.	Greyish smoke cloud.
Effects on body.....	Immediate sneezing followed by headache, nausea, and vomiting. Temporary physical debility. Effective in low concentrations but is delayed about 5 to 10 minutes.	Sneezing and burning sensation of the nose and throat. Slight lacrimation followed by occasional nausea, headache, and temporary debility. Immediately effective.
First-aid treatment.....	Remove to pure air and make as comfortable as possible in the shade.	Remove to pure air and make as comfortable as possible in the shade.
Persistence.....	While burning, drifts with the wind, will remain in low and protected places for some time. General, 5 minutes in open.	While burning, drifts with the wind; will remain in low and protected places for some time. General, 10 minutes in open.
Action on food and water.....	Poisons unprotected food and water; cannot be made safe for use.	Poisons unprotected food and water; cannot be made safe for use.
Action on metals.....	Very slight.	None when dry.
How used.....	<i>For harassing effect.</i> In candles or generators.	<i>For harassing effect.</i> In candles or shell.
Protection required.....	Gas mask with a good filter.	Gas mask with a good filter.

SCREENING SMOKES

NAME and SYMBOL	SULFUR TRIOXIDE SOLUTION (FS)	HC MIXTURE	WHITE PHOSPHORUS (WP)
Odor.....	Acid or acrid.	Acrid, suffocating.	Like phosphorus matches.
Color and state in field.....	Dispersed as liquid which changes to white smoke upon contact with air.	White smoke produced by burning munitions only.	Dispersed as solid which rapidly burns on contact with air, producing white smoke.

NAME and SYMBOL	SULFUR TRIOXIDE SOLUTION (FS)	HC MIXTURE	WHITE PHOSPHORUS (WP)
Effects on body-----	Mild pricking sensation to skin; noninjurious.	None-----	Smoke, none; particles produce severe fire burns which heal very slowly.
First-aid treatment-----	None necessary for smoke; for liquid agent, wash affected parts with water and then with soap and water.	None needed-----	Quench burning bits of phosphorus with water or by covering with a wet cloth (handkerchief wet with water from canteen); remove par- ticles of phosphorus with stick or knife; if unable to remove, keep covered with wet cloth until re- moved at an aid station.
Action on food and water----	Liquid renders food and water unfit for use; smoke gives disagreeable odor.	Smoke gives disagreeable odor.	Smoke gives disagreeable odor; solid is poisonous.
Action on metal-----	Vigorous corrosion in presence of moisture.	None, if dry-----	None.
How used-----	<i>Screening smoke.</i> In airplane spray for screening; in artillery shell, mortar shell, and cylinders for training to simulate cloud gas.	<i>Screening smoke.</i> In gre- nades by the air forces; in smoke pots or candles for training only.	<i>Screening smoke and incendiary.</i> In artillery shell and mortar shell, primarily for smoke effect; also used in same munitions and air- plane bombs for casualty effect and incendiary action.
Protection required-----	None-----	None-----	For smoke, none; for burning par- ticles, none provided.

■ 7. CHEMICAL AGENTS.—*a. Lung irritants.*—The principal lung irritants are phosgene and chlorpicrin. The gas mask effectively protects the wearer from these gases.

(1) *Phosgene (CG).*—This agent is a nonpersistent gas. Upon release it reacts with water vapor in the air to form a white cloud which is soon transformed to a colorless gas. It is approximately nine times as toxic as chlorine, the original "war gas." A few breaths in the average field concentration produces a casualty. However, the effects may be delayed. Being heavier than air, phosgene collects in low or protected places, and in such places may remain in effective concentrations for as long as 1 hour. On high, open terrain it is dissipated from the point of dispersion in 10 minutes or less. The moisture present in the air is sufficient to hydrolyze a small portion of the phosgene cloud and produce hydrochloric acid, which will corrode metals. Phosgene may be released from cylinders, loaded into shell and fired from Livens projectors, chemical mortars, and artillery weapons, or dropped in aerial bombs. Its odor is that of cut corn and is very pungent.

^ (2) *Chlorpicrin (PS).*—Chlorpicrin is an oily liquid. In the open it slowly changes to a colorless gas. A lung irritant and a lacrimator, it is approximately one-half as toxic as phosgene. It is slightly corrosive to metals. Chlorpicrin is persistent, remaining effective from 1 to 12 hours, depending upon temperature and terrain. It may be used either as a casualty or harassing agent, and may be dispersed by bombs, shells, or airplane spray. The characteristic odor is that of flypaper.

b. *Vesicants.*—The principal vesicants are mustard gas and lewisite.

(1) *Mustard gas (HS).*—Mustard gas, classed as a persistent agent, is normally a dark brown liquid which changes slowly to a colorless gas. In its pure form it is colorless and approximately four times as toxic as phosgene. Dispersal is by means of artillery shell, mortar shell, airplane spray, bombs, land mines, and pressure sprinklers. The rate of vaporization varies with the temperature, wind conditions, vegetation, and the method of dispersion. Under average conditions in summer it will persist from 4 to 5 days in the open

and up to a week in woods. In winter it may remain for several weeks, and in tropical jungle terrain may not disappear until the lapse of several months. Mustard gas is used for its casualty effect or to deny ground through threat of casualties. In impure form it has the odor of garlic or horseradish, while in pure form, it may be nearly odorless. It is only slightly corrosive to metals.

(2) *Lewisite (M1)*.—Lewisite, colorless in its pure state, is normally a dark brown liquid which changes slowly to a colorless gas. When breathed, it is approximately six times as toxic as phosgene. Under average conditions in summer it persists for 24 hours in the open and from 2 to 3 days in woods. In winter it may last for a week or more, and in tropical jungle terrain for as much as a month. Lewisite is rapidly hydrolyzed by water to M1 oxide, which is an extremely vesicant solid. It is used for its casualty effect or to deny ground through threat of casualties. Nearly odorless in pure form, it has the scent of geraniums when impure. It is slightly corrosive to metals.

c. *Systemic poisons*.—(1) *Hydrocyanic acid*.—Hydrocyanic acid (formula, HCN) is a colorless, nonpersistent gas of slightly less density than air, a fact which adds to the difficulty of using it as a toxic agent. It is nonpersistent and is rapidly decomposed by water. Its toxicity is approximately three times that of phosgene, and its faint odor is that of bitter almonds or peach kernels.

(2) *Arsine*.—Arsine (formula, AsH_3) is a colorless, flammable, nonpersistent gas with a characteristic garliclike odor and metallic taste. A very small concentration may cause toxic symptoms.

d. *Lacrimators*.—(1) *Chloracetophenone (CN)*.—Chloracetophenone, a solid, is converted by external heat to a colorless gas. In the solid state CN is persistent, but is nonpersistent as a gas. It is not affected by water and has only a slight corrosive effect upon metals. Chloracetophenone is used for harassing purposes, and may be dispersed by means of candles or grenades of the burning type. In dilute concentrations it has the odor of apple blossoms.

(2) *Chloracetophenone solution*.—(a) *CNS*.—Solid chloracetophenone is dissolved in a mixture of chlorpicrin and

chloroform to produce a more persistent harassing agent known as CNS. In summer this is effective for a period of 1 hour in the open and 2 hours in woods, while in winter it may last as long as 6 hours in the open and a week in wooded areas. CNS is used in training and is dispersed from cylinders or as airplane spray. It may also be used in combat by mortars, artillery, or in explosive type grenades or bombs.

(b) *CNB*.—Another solution of chloracetophenone can be made by dissolving the solid in equal quantities of carbon tetrachloride and benzene, producing CNB which can be used in much the same manner as CNS. It is essentially a training agent.

(3) *Brombenzylcyanide (CA)*.—Brombenzylcyanide is a more powerful and more persistent lacrimatory agent than chloracetophenone. It may persist for as much as 3 days in the open and 7 days in woods, while on the ground in winter it may be effective for as much as 20 days. Brombenzylcyanide is very corrosive to iron and steel, and for that reason a lead, glass, or enamel lined container must be employed.

e. Irritant smokes.—Harassing agents, capable of producing violent sneezing and nausea, are adamsite and diphenylchlorarsine.

(1) *Adamsite (DM)*.—Adamsite, or diphenylaminechlorarsine, is a yellow crystalline solid. When used in the field it is vaporized in burning-type munitions to produce a yellow smoke of finely divided solid particles. This yellow color is the best means of identification, as the agent is practically odorless. DM has very little effect upon metals but will render food unfit for use. It is a nonpersistent harassing agent, persisting at the point of release for about 5 minutes. Since it is a finely divided solid when dispersed, it can be removed only by a mechanical filter in the canister of the gas mask.

(2) *Diphenylchlorarsine (DA)*.—Diphenylchlorarsine is a white solid. When heat is applied, it distills to fine smoke particles, grayish in color. DA, classified as an irritant smoke, is capable of producing slight lacrimation in addition to sneezing and nausea. It is a nonpersistent agent, being effective at the point of dispersion for less than 10 minutes.

The smoke fumes are more easily ignited than those of DM. Like adamsite, diphenylchlorarsine is a harassing agent. Since it is a finely divided smoke, it can be removed only by the mechanical filter in the canister of the gas mask. Corrosion of metals is more pronounced with DA than with DM.

f. Screening smokes.—Screening smokes are employed in both defensive and offensive operations. The principal agents are sulfur trioxide solution, HC mixture, and white phosphorus.

(1) *Sulfur trioxide solution (FS).*—A solution of sulfur trioxide in chlorosulfonic acid is the most generally used substance for airplane smoke screens. It is also employed extensively as a training smoke. The solution hydrolyzes readily in air, producing a dense white smoke which drifts with the wind. It has a very high obscuring value. Since FS is very corrosive to metals and is injurious to fabrics, care in its use is necessary. Dispersal is by means of artillery shell, mortar shell, cylinders, land mines, and airplane spray. Its vapors produce a prickling sensation of the skin and the liquid will cause burns upon coming in contact with the flesh. The smoke cloud persists in the air for a period of from 30 to 60 seconds. A gas mask is not needed for protection against the ordinary FS smoke cloud.

(2) *HC mixture.*—This consists of finely divided zinc and hexachlorethane which burns and produces a dense grayish-white smoke. Screens are developed by various size candles or smoke pots. The obscuring value of HC is not so high as that of FS, but the large volume of smoke and its continued evolution is sometimes more desirable. Its fumes are non-injurious to personnel, animals, fabrics, or metals. The mixture is primarily a training agent.

(3) *White phosphorus (WP).*—White phosphorus is a white or amber solid which ignites spontaneously upon exposure to air, producing a dense white smoke. It has the highest obscuring value of any smoke-producing substance. White phosphorus must be protected from the air until it is loaded directly into shell, bombs, or land mines. It ignites when the container is shattered. It is also useful as an incendiary and for its casualty effect upon personnel.



FIGURE 1.—White phosphorus burst.

g. Incendiary agents.—The purpose of incendiary agents is to set fire to combustible material. They may also cause casualties to personnel. The principal ones are thermit, magnesium, white phosphorus, and oil.

(1) *Thermit.*—(a) *General.*—Thermit is an intimate mixture of iron oxide and finely powdered or granular aluminum. When a suitable starter is used, the aluminum reacting with the iron oxide, generates a high temperature ($4,500^{\circ}$ F.), producing molten iron. This reaction in the small incendiary bomb proceeds rapidly for a period of 1 to 2 minutes depending upon the amount used. Thermate is a modification of thermit. It is a mixture of iron, aluminum, barium nitrate, and small amounts of sulfur and castor oil.

(b) *Counteractive measures.*—As thermit will continue to burn under water, it is useless to turn a hose upon it. In such a case the steam generated is likely to produce an explosion and scatter the burning mass, thus generalizing the effect. As soon as the thermit burns out, the resultant blaze may be handled as an ordinary fire.

(2) *Magnesium.*—(a) *General.*—The German “Elektron” bomb, used widely in World War II, consists of a cylinder of magnesium alloy 2 inches in diameter and 10 inches long with $\frac{1}{2}$ -inch walls. An impact fuze in one end of the bomb ignites the primer filling in the tube, consisting of a thermit mixture which, upon burning, will in turn ignite the magnesium case. This case will continue to burn from 10 to 15 minutes at a temperature of about 2,300° F. American magnesium bombs are described fully in TM 3-330.

(b) *Counteractive measures.*—No attempt should be made to extinguish the bomb during the first minute of burning since molten iron may be thrown a distance of 50 feet by the violent combustion of the thermit starting mixture. After the thermit reaction has ceased, the rate of burning of the magnesium may be greatly accelerated by a fine spray of water. *Caution:* Do not direct a stream of water upon burning magnesium as an explosion is likely to result. Commercial soda-acid and foam extinguishers may be used on the magnesium bomb provided a stream of liquid is not directed on the bomb itself. The best method consists of placing the thumb over the nozzle so that a fine spray is obtained. Carbon tetrachloride extinguishers should not be used, as the toxic gas, phosgene, is formed when the burning magnesium is struck by the liquid. Similarly, carbon dioxide extinguishers should not be used, as carbon monoxide, another deadly gas, may be formed. If no spray is available, with a long-handled shovel roll or scrape the burning mass onto a layer of sand approximately 3 inches thick and promptly cover with additional sand. This will not extinguish the burning metal but will localize the heat. If possible, scoop up the sand and burning bomb with the shovel, place in a bucket containing a 3-inch layer of sand and carry (by inserting shovel handle through bucket handle) to a non-combustible place.

(3) *White phosphorus.*—(a) *General.*—White phosphorus is not a satisfactory incendiary agent because of its low burning temperature. However, flammable materials such as grain fields, dry grass, and leaves will ignite from burning phosphorus. One so-called “calling card” consisted of a flammable card moistened with a solution of phosphorus and

dropped in grain fields. When the solvent evaporated, the phosphorus ignited spontaneously, setting fire to the card and in turn to the grain fields. Another method used bits of phosphorus held with porous muslin against celluloid. White phosphorus is also used in shell fillings, land mines, bombs, and certain grenades. Particles of burning phosphorus thrown from a shell inflict painful injuries on personnel.

(b) *Counteractive measures.*—White phosphorus is easily extinguished by water, but care should be taken to remove all particles from flammable materials or the skin. To render them inactive, a solution of copper sulfate should be applied before they are removed.

(4) *Oil.*—(a) *General.*—Since the heat of combustion of oils is very high, they are useful incendiary agents. Very simple containers and ignition devices may be used. Small pieces of metallic sodium are sometimes added to the oils to prevent the fire from being easily extinguished with water since the sodium will react with water to rekindle the fire.

(b) *Counteractive measures.*—Foam extinguishers or carbon tetrachloride extinguishers may be used successfully against oil fires. Streams of water usually tend to spread the oil instead of extinguishing it.

■ 8. *How to Test for Odors.*—An important phase of training in individual protection is the development by the individual of an ability to recognize the presence of chemical agents by their odor. To aid in this instruction there is available for indoor use the "Set, Gas Identification, Instructional, MI," and for outdoor instruction the "Set, Gas Identification, Detonation, MI."

a. *Set, Gas Identification, Instructional, MI.*—(1) *Description.*—This is a sniff set consisting of seven 4-ounce wide-mouth glass bottles filled with samples of chemical agents. Two bottles contain charcoal saturated with mustard gas; one bottle contains charcoal saturated with chlorpicrin, and one with lewisite; and one each contains diphenylaminechlorarsine, chloracetophenone, and simulated phosgene (triphosgene) in solid form. Triphosgene, upon contact with the air, decomposes and gives off phosgene. The charcoal used in these bottles is the standard gas mask type

activated charcoal which has been thoroughly dried before saturation with the chemical agent. For authorized allowances of these sets, see Tables of Allowances for Posts, Camps, and Stations.

(2) *Replacements.*—When the contents of several sniff bottles have deteriorated to the extent that detectable odors no longer are given off, requisition should be made for the necessary sample replacement sets. These consist of units of two bottles of agents packed in a wooden box. Upon receipt, the newly filled bottles should be placed in the standard set. Empty bottles should be placed in the sample replacement box for immediate return shipment.

(3) *Method of testing.*—(a) The proper method of detecting the odor of chemical agents in the bottles is to take a moderately full breath immediately before opening a sample bottle. Upon opening, care should be taken to keep the face away from the bottle, as gas pressure may have developed to the extent that some of the agent might strike the eyes when the stopper is removed. The open bottle should be held in the left hand and about 10 inches in front of the nose and the right hand used to fan air across the bottle mouth toward the nose. At the same time air should be sniffed, avoiding deep inhalations. If the odor is not discovered the first time, the bottle should be brought progressively closer until a distinct odor is obtained. As soon as the odor has been detected, the stopper is replaced in the bottle.

(b) If the odor does not correspond to that assigned to the agent in the table of characteristic odors, the student should note exactly what odor the agent does give to him. There is more variation in odor determination than in any other sensory perception. It is to be expected that different men will describe the same odor in different terms. All odors become more penetrating and stronger as the concentration is increased, so the concentration as well as the individual variation in odor perception must be considered when identifying chemical agents from sniff bottles.

(c) There is no danger associated with identifying chemical agents prepared in this way. The best results are obtained if a minimum interval of 15 minutes elapses between sniffs. The method of instruction used in sniff bottles is

applicable to small groups only and usually will be limited to use in training gas officers, gas noncommissioned officers, gas sentries, and gas reconnaissance detachments.

(d) As a final test of ability to recognize the odors of the various agents, the instructor should cover each bottle with a plain paper wrapper and number each bottle before giving the test.

b. *Set, Gas Identification, Detonation, MI.*—(1) *Description.*—This set consists of 48 sealed pyrex glass tubes, each 1 inch in diameter, $7\frac{1}{2}$ inches long, each containing approximately 1 ounce of the agent or a solution of the agent. Twelve tubes each of mustard gas, lewisite, phosgene, and chlorpicrin are provided. The amount of agent in the tubes is sufficient to produce an easily identifiable odor when detonated.

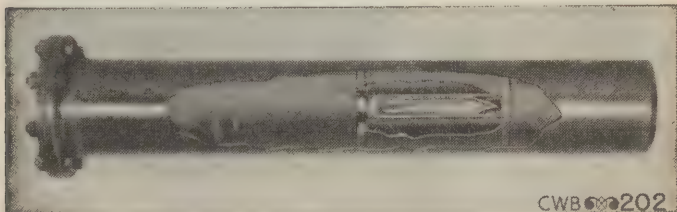
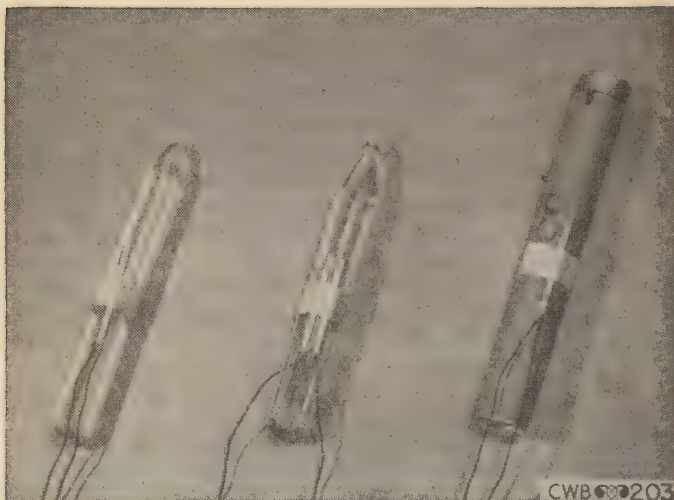


FIGURE 2.—Shipping container—detonation tube.

(2) *Method of shipment.*—Multiple tube containers and individual tube containers cannot be shipped by common carrier unless securely packed in a steel shipping container. Consequently, it is necessary to return the shipping container when replacements are required.

(3) *Method of use.*—This set is intended for use outdoors and will be found valuable in training individuals to identify chemical agents under field conditions. Individual gas tubes containing the agent should be prepared for detonation by attaching to them one or two No. 8 commercial detonators as shown in figure 3. Gas tubes should be wired for detonation as shown in figure 4. Printed instructions for the use of this set (figs. 3 and 4) are placed in an individual tube and packed in each multiple tube container. The following practical details should be observed when using this identification set:



① M+1 or PS.

② HS.

③ CG.

FIGURE 3.—Tubes of agents with detonators attached.

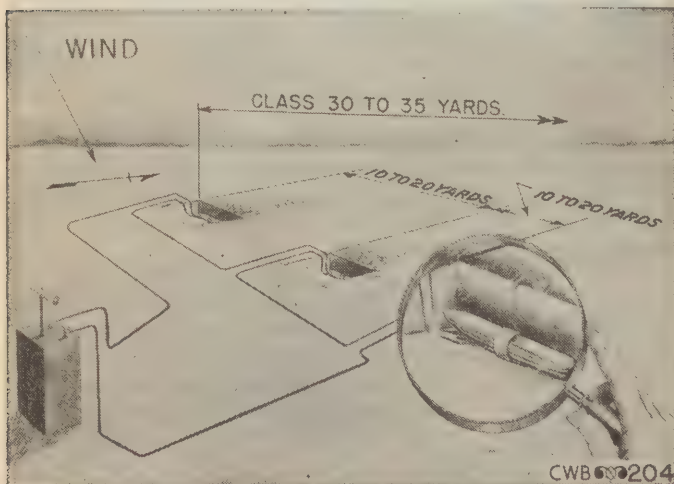


FIGURE 4.—Wiring diagram—detonation test.

(a) A line of holes about 10 to 20 yards apart should be dug at right angles to the wind direction and one tube of agent placed in each hole. One tube is sufficient for about 25 men. At a signal, an assistant detonates the tubes by means of a blasting machine and the instructor advises the students to sniff the air when he believes the cloud has reached them. A wind indicator is set up near the blasting machine to indicate the direction and nature of the wind. In a shifting wind the students will change position accordingly so as to be in the path of the agent. As soon as the students have obtained the odor of the agent, they will move to either flank and out of the cloud.

(b) The blasting machine should be placed about 25 yards up wind from the firing line, and the class stationed from 30 to 35 yards down wind. On calm days this distance will be from 20 to 25 yards, but on windy days it may be necessary to extend the distance to 40 to 45 yards.

(c) If students do not obtain a satisfactory identification of the agent, a spade is used to take a sample of earth from the detonation hole. This is carried at least 5 yards down wind so that the class will not contaminate its shoes. Then each student should pass and sniff the odor of the agent given off by the earth.

(d) Upon detonation, pieces of glass and liquid spray may be thrown as far as 15 yards. No person or animal should be within this danger radius when the gas tubes are detonated.

(e) Vegetation in the immediate vicinity of the detonation hole may be contaminated from HS and M1 firing, and the ground in the detonation hole will be dangerous for some time. Suitable precautions must be taken to prevent burns.

(f) After a demonstration, all detonation holes are filled and pieces of glass and wire removed from the area.

(g) One No. 8 detonator is used on tubes containing phosgene, chlorpicrin, and lewisite, while two No. 8 detonators are usually desirable on mustard gas tubes.

(h) Detonators should be placed beneath the tubes so that the force of the explosion will throw the liquid into the air and produce an ample cloud of vapor.

(i) Phosgene should always be fired in the cardboard tube in which it is shipped in order to prevent explosion due to increased gas pressure formed by heat or low atmospheric pressure. The detonator should be taped to the outside of the cardboard tube.

(j) If a blasting machine is not available, detonators may be fired with batteries if a parallel circuit is used.

(k) Seventy No. 8 detonators are furnished with each set. Additional detonators should be requisitioned as needed.

■ 9. GENERAL FIRST-AID MEASURES.—Casualties from exposure to chemical agents are produced only when the individual tolerance of the man for that agent has been exceeded. For example, a man may be exposed to slight concentrations of certain agents, and suffer no harmful effects, whereas with other agents only a breath in the same concentration may cause serious consequences. The prolonged exposure to a weak concentration has the same effect as an exposure of short duration to a heavy concentration.

a. Need of first-aid treatment.—Competent first aid during or immediately after a gas attack may be the means of preventing mortality or reducing the severity of casualties. Different agents require different and specific methods of treatment. It is, therefore, imperative that there be a thorough knowledge of first aid with respect to chemical warfare casualties.

b. The gas mask.—The gas mask is the best individual protection against chemical agents. It is important to learn by practice how to put the mask on quickly and effectively. If a patient is unconscious, his mask should be adjusted by the person administering first aid.

c. Tear gas.—The tear gases, or lacrimatory gases, act upon the eyes. They produce acute pain, profuse outpouring of tears, and spasm of the eyelids.

(1) Tear gases usually do no permanent damage to the eyes, and the effect is generally of comparatively short duration. But during the period of their action they cause almost complete inability to see.

(2) First aid is usually the only treatment necessary. Individuals exposed to lacrimators should be removed from

the contaminated atmosphere and faced into the wind with the eyes open. If this procedure is not possible, the mask should be put on, the eyes kept open as much as possible, and rapid breathing maintained. Under no circumstances should the eyes be rubbed as this increases the irritation. Eyes seriously affected should be treated at an aid station. It is usually unnecessary to evacuate patients exposed to lacrimators.

d. Irritant smokes.—The irritant smokes cause irritation of the nose and throat. Sneezing is often violent and persistent, and there is a watery discharge from the nose. Secretion of saliva is markedly increased. There is also coughing, pain at the base of the nose, severe headache, nausea, and vomiting. Mental depression is a characteristic effect of this group of chemicals, and may be so marked that the individual may have to be forcibly restrained from self-injury.

(1) *Damage.*—Usually little or no permanent injury results, although at the time there is very real distress. The effect of an irritant smoke may be either immediate, or delayed for as much as 10 minutes or longer. The effects last from 3 to 4 hours.

(2) *First-aid treatment.*—The individual is removed to pure air if possible. If this cannot be done, the mask must be worn between spells of actual vomiting. The patient should be required to lie down, his clothing should be loosened, and he should be kept away from heat. Inhalation of dilute chlorine from a small amount of bleaching powder in wide-mouth bottle is an effective treatment. The patient's nose and throat may be bathed with warm, weak solutions of baking soda, 1 teaspoonful to 1 pint of water. If vomiting has resulted, copious draughts of the weak sodium bicarbonate solution will help to relieve him. It is usually not necessary to evacuate patients affected by an irritant smoke. However, such cases should be observed by a medical officer as the more serious ones may require evacuation.

(3) *Mental effects.*—In addition to the mental depression caused by irritant smokes, the effect upon morale must be considered. The morale of the patient may be improved by informing him that his condition is not serious.

e. Lung irritants.—Lung irritant gases are dangerous and may cause death if a person is exposed to them for a long period.

(1) *Symptoms produced.*—The symptoms vary considerably with the particular gas and with its concentration. There is usually irritation of the nose and throat, coughing, difficulty in breathing, pains in the chest, vomiting, and a blue pallor of the lips and ear lobes in more severe cases.

(2) *Appearance of symptoms.*—As a rule, symptoms of injury to the lungs do not appear at once. Usually 2 to 4 hours, or longer, elapse before symptoms are noticed. This is called the "latent period." It is important to remember that even though first symptoms are slight, more serious effects may follow.

(3) *Treatment of casualties.*—Patients suspected of having breathed lung irritant gases should be given absolute rest. All casualties known or suspected of having been seriously exposed should be considered as litter cases.

(4) *First-aid treatment.*—If unmasked, the mask should be adjusted and the patient removed from the gas area if possible. When he has been carried to a place free of gas, the gas mask is removed, his clothing loosened, and the man kept completely still, relaxed, and warm with blankets. Non-alcoholic stimulants such as hot coffee or tea may be given. This type patient should be evacuated on a litter to an aid station as soon as possible.

(5) *Danger period.*—The greatest period of danger for the patient who has been exposed to a lung irritant gas is the first 48 hours. Most deaths occur within this time.

(6) *Precaution against artificial respiration.*—Artificial respiration must not be used on lung irritant gas casualties. The lungs may be seriously damaged and possibly in a water-logged condition. Artificial respiration will do more harm than good, and may even cause sudden death.

f. Vesicant gases.—This group of gases has certain special characteristics which should be considered separately.

(1) *Persistence and effectiveness.*—(a) *Persistence.*—Gases of this group are normally liquids of a somewhat oily consistency. Under normal weather conditions in temperate climates some of them may persist for days if the original

contamination is heavy and if the area affected is sheltered from direct action of wind and sunlight.

(b) *Effectiveness.*—Their effectiveness is so great that a drop the size of the head of a small pin can produce a blister the size of a quarter. Exposure to a vesicant vapor of a few parts per million of air for an hour is capable of producing a casualty. Action on the eyes is particularly marked.

(2) *Penetration of materials and of the body.*—Ability of vesicant agents to penetrate is one of their characteristics. They “soak in” just as ink soaks into a blotter. This is not the same as “eating in,” as when an acid acts upon a metal. The soaking in takes place without any damage to the material, such as clothing, etc. These chemicals also are absorbed by the body. About the only substances which resist this power of penetration are metals, glass, and highly glazed tiles or porcelain.

(3) *Insidious character.*—The presence of vesicants such as mustard gas, may not be very obvious, either by smell or by any particular sensation, such as burning. On the other hand, lewisite, another of the chemicals of this group, has the characteristic odor of geraniums.

(4) *Delayed action.*—One of the important peculiarities of this group, and one which makes all of its members dangerous, is that, while actual injury takes place rapidly, the recognizable signs of such injury do not appear for a considerable time. Thus a patient may be contaminated without knowing it, and may show no signs of injury for several hours. However, the average time of the development of clinical signs or symptoms is from 2 to 4 hours for mustard gas, and even sooner for lewisite.

(5) *General action.*—Unlike agents of the other groups, the effect of vesicants are not confined to any one area of the body. They have the power to burn and blister any area with which they come into contact, either as liquid or vapor. This is equally true of areas within the body.

g. Effects of vesicant gases.—Injury induced by these gases varies somewhat with the area affected. The parts of the body most generally affected by vesicants are:

(1) *Eyes.*—The eyes are very liable to injury, from both liquid and vapor. Although there may be some delay in ap-

pearance of signs, such delay is less than with other areas of the body. A few hours after exposure to vapor, inflammation sets in, with smarting, watering, and finally closure from swelling of the eyelids. Conditions rapidly grow worse. There is discharge and much pain, especially upon exposure to light. Prompt medical attention is imperative.

(2) *Respiratory system*.—Inflammation of the throat and windpipe as a result of breathing contaminated air is fairly common. A dry mouth and burning throat, with a harsh ringing cough, result. This cough is very characteristic and most distressing. Partial loss of the voice is common. In severe cases the action on the lungs may produce pneumonia.

(3) *Digestive system*.—Inflammation of the stomach, with pain and vomiting, may occur. This is the result of swallowing contaminated saliva, food, or drink.

(4) *Skin*.—Injury to the skin develops in three stages: reddening like sunburn, blistering, and finally open sores. How far the casualty progresses toward the final stage depends upon the original concentration of the agent and the duration of the patient's exposure. In case of contamination by liquid, blistering always occurs if steps are not taken at once to counteract the effects. The areas of the skin most likely to suffer are those which normally are moist, such as the bend of the elbows and the knees, the armpit, and the crotch. The genitals are particularly susceptible to attack.

h. Death rate from vesicant gases.—It is encouraging to know that, while the number of casualties due to these agents is high, due chiefly to their persistence and insidiousness, the death rate is low.

i. First-aid treatment of vesicant casualties.—Immediate treatment following contamination is very important. First aid must take into consideration the latent period. Where possible, the exposed person after emergency treatment should report immediately to the aid station for further attention.

(1) *Eyes*.—First-aid treatment for vesicants in the eyes consists of washing them freely with water. This washing should be done as soon as possible after exposure and the patient led or directed to an aid station.

(2) *Breathing passages and digestive system.*—First aid cannot cope with these conditions. Patient should be handled the same as a lung irritant casualty and hospitalized as soon as possible.

(3) *Skin.*—In many instances there is a delay of some hours between the time when the chemical agent comes into contact with the individual and the time when he develops recognizable signs of injury. If liquid mustard gas is discovered on an individual's clothing or skin, two first-aid measures may be taken: the chemical agent may be washed from the clothing, or it may be neutralized. If liquid has reached the skin, it should be blotted with dry gauze or cloth. The protective ointment M4 is then rubbed thoroughly upon the affected area and the excess removed with a clean cloth. If this ointment is not available, bleaching powder or paste may be used. If bleaching powder or protective ointment is not available, the liquid agent may be removed by dabbing with a clean cloth moistened with kerosene (coal oil), gasoline (preferably not ethyl), alcohol, or carbon tetrachloride (the solution found in the pump-type fire extinguisher attached to Army vehicles). If only mustard gas vapor has reached the skin the time allowed before application of first-aid measures may be longer. Protective ointment may be thoroughly rubbed on the affected areas. If bleaching powder or protective ointment is not available, use of the solvents noted above or soap and water will remove some of the poisonous agent. When bleaching powder is used, the most effective method of its application is to make a paste of a small quantity of the powder with water, the mixture being carefully stirred while being prepared. Usually equal volumes of water and powder are used. The contaminated area of skin is covered as well as the immediately surrounding area. The paste is rubbed in well for about 1 minute and then removed after not more than 5 minutes by wiping with a dry rag or by flushing with a large quantity of water, if available. A subsequent bath with soap and water is desirable. Care must be taken not to get bleaching powder paste into the eyes. If the skin has already begun to show definite redness or blisters, the bleaching powder or protective ointment should not be used, as it is irritating. In case of

lewisite contamination immediate removal of decontaminated clothing, absorption of liquid agent on the skin with a clean cloth, washing with soap and water, and application of protective ointment will be the only treatment possible. Blisters should be protected from breaking, for the liquid from blisters caused by lewisite is vesicant.

j. First-aid treatment for incendiary casualties.—(1) *White phosphorus.*—Should the injury be the result of white phosphorus particles, the afflicted area is immersed in or flushed with any water available in order to extinguish the burning phosphorus.

(2) *Other incendiaries.*—Injuries sustained from incendiaries other than white phosphorus should be treated as ordinary burns. For first degree burns, or burns of the skin only, wet dressings of sodium bicarbonate or salt should be applied. For more serious burns the patient should be treated for shock, kept quiet and warm, and his feet elevated.

k. Systemic poisons.—Gases which cause general or systemic poisoning have been used in warfare, but without much success. Some such gas may result from explosion of projectiles. The two gases in this group needing consideration are hydrocyanic acid, having the faint odor of bitter almonds or peach kernels, and arsine with an almost undetectable odor of garlic.

(1) *Hydrocyanic acid.*—(a) *Symptoms.*—Following inhalation of high concentrations of hydrocyanic acid, dizziness, headache, irregular pulse rate, and labored breathing come on very rapidly, followed shortly by coma, convulsions, and death. Low concentrations may produce headache, dizziness, and nausea.

(b) *First-aid treatment.*—The patient should be removed to pure air and given artificial respiration, until proper medical authority arrives.

(2) *Arsine.*—(a) *Symptoms.*—In mild cases there may be lassitude, headache, and uneasiness. With increased exposure, chills, nausea, and vomiting occur. In severe cases the blood is strongly attacked, with resulting anemia. Urine will be a deep brown to red color.

(b) *First-aid treatment.*—The mask should be adjusted and the patient removed by litter to fresh air. Under no circumstances should he be permitted to walk or exercise. Hospitalization must be immediate.

SECTION III

FACTORS OF NATURE AFFECTING THE USE OF
CHEMICAL AGENTS

■ 10. WIND.—*a. Direction.*—In planning any defense against chemical attack, the direction of the prevailing wind must be considered. The form a chemical attack may take may often be predicted by observation of the wind direction.

b. Velocity.—Winds of low velocity are likely to change direction, while winds of high velocity are not favorable to gas or smoke clouds. Velocities of from 3 to 12 miles per hour are most favorable to the release of gas or smoke clouds. Small incendiary bombs can profitably be used in winds of high velocity, as such winds assist in scattering the bombs over a large area and augment resulting fires. (See app. II.)

■ 11. AIR DRAINAGE.—Cool air tends to drain into low places. Chemical agents are carried by this movement. For this reason, troops preferably should not be bivouacked in valleys and depressions when a gas attack is possible. This principle should also be applied to the establishment of first-aid stations, command posts, artillery emplacements, ammunition dumps, and similar installations.

■ 12. TEMPERATURE.—The rate of evaporation of chemical agents is controlled by the temperature. Vaporization in warm weather is accelerated; in subfreezing weather it is practically stopped. The persistency of a particular agent is therefore dependent upon the temperature. Since the nonpersistent agents are more volatile than the persistent ones, a relatively cooler temperature is more favorable. Persistent vesicant agents are most effective when the temperature is warm enough to produce sufficient vapor to cause skin and lung casualties, but not so warm that rising air currents will be present.

■ 13. TIME OF DAY.—*a. Temperature effects at night.*—During daytime the temperature over a limited area is about the same whether in valleys or on small hills. At night the layer of air next to the ground grows colder and denser and flows like water into valleys and places of low elevation. If the wind is of low velocity it is unable to move these pockets of

cold air, so a wide variation of temperature will be found between high and low ground. Should the velocity of the wind be above 5 miles per hour, these pockets of cold air will be removed and very little variation in temperature will be apparent. Because of this tendency of cold air to flow into the valleys and depressions, such places in the vicinity of gassed areas will, on calm nights particularly, be likely to contain dangerous concentrations of toxic agents. This matter should receive careful consideration in the disposition of troops and establishment of installations.

b. Temperature effects during the day.—In early morning the air next to the ground is cool, and as a rule there is very little wind. During the day the ground is heated faster than the air, and air movement is developed by convection currents. In the late afternoon the earth is warmer than the surrounding air and convection currents are still present. In the evening the earth cools rapidly and air drainage is started toward the depressions and valleys.

■ 14. PRECIPITATION.—*a. Fog.*—Some chemical agents, such as phosgene, are hydrolyzed by moisture. Phosgene dispersed during a fog unites with the fog particles and soon becomes ineffective. Smoke screens, on the other hand, are doubly effective in fog since most smoke agents tend to unite with water vapor to produce larger particles with greater obscuring effect.

b. Rain.—(1) *Effect upon persistent casualty agents.*—A gas cloud is washed from the air and beaten to the ground by rain. Mustard gas does not hydrolyze to any great extent, but lewisite readily hydrolyzes, forming a toxic vesicant solid.

(2) *Effect upon nonpersistent agents.*—The concentration of clouds of nonpersistent agents is immediately lowered by rain due to washing out from the air. Phosgene, if liberated during a heavy rain, is almost immediately hydrolyzed and the products formed by hydrolysis are not toxic in the field.

(3) *Effect upon irritant smokes.*—Since irritant smokes are not hydrolyzed, light rains and mists are to some extent favorable and may be of assistance in hiding the characteristic color of the cloud. Heavy rains wash the agent from the air.

(4) *Effect upon screening smokes.*—Screening smokes are favored by light rain or mist, since the necessary water is furnished for the hydrolysis reaction. Light rain and mist restrict visibility and reduce the amount of screening smoke necessary. This is due to the obscuring power of the mist and to the increased efficiency of the smoke in the damp air. However, heavy precipitation tends to beat the smoke cloud down and wash it from the atmosphere.

c. *Snow.*—(1) *Effect upon persistent agents.*—If snow or sleet falls upon an area already contaminated with a persistent agent, the agent becomes less potent, due to the effect of hydrolysis and also to the blanketing of the agent. Then, as the snow melts, the agent soaks into the ground and also is hydrolyzed. In the case of lewisite, this hydrolysis is more rapid than with mustard gas. Low temperature accompanying snowfall also lowers the rate of evaporation of the agent. If mustard gas is projected on top of snow, the low temperature causes it to solidify, and in this state the vapor concentration is so low as to be harmless. It must be kept in mind, however, that solid particles of frozen mustard gas may adhere to clothing when the wearer is passing through contaminated undergrowth or snow, and that these particles will cause burns when they melt if they or their vapors come into contact with the body.

(2) *Effect upon nonpersistent agents.*—Snow on the ground has very little effect upon nonpersistent agents. If the agent is projected during a snow storm, the water film on each snowflake will absorb the gas and render it ineffective.

(3) *Effect upon screening and toxic smokes.*—Snow on the ground will have little or no effect upon smokes. If the agent is released during a heavy fall of snow, the agent will adhere to the particles of snow and be carried to the ground. During the fall of snow the obscuring effect of a screening smoke is reinforced by the snow so less smoke need be used. Also, in cold weather there will be less rise of the smoke cloud because of lack of convection currents.

■ 15. **TERRAIN AND TOPOGRAPHY.**—a. *Influence of shape of corridors in defense against chemical warfare.*—A cross compartment or corridor is best suited for defensive operations. The defender may prepare obstacles in addition to such

natural ones as streams by releasing persistent agents in the vegetation and wooded areas in proximity to the stream. Gas sentries and reconnaissance details must be on the alert for such preparations and obstacles.

b. Considerations of terrain relating to tactical uses of chemicals.—(1) *Ridge and drainage systems.*—Terrain features which tend to protect personnel from gunfire are usually undesirable with regard to defense against chemical attack. Normally ridges are to be avoided as much as possible because personnel are exposed as targets for hostile rifle fire. Depressions and valleys are considered better protection against enemy fire. In defense against chemical attack low terrain features and depressions are to be avoided in view of the fact that toxic chemical vapors, being heavier than air, tend to seek out these locations. To take advantage of terrain features which will afford protection from both hostile fire and chemical attack requires the combination of both high ground and defilade protection which the reverse slope of a hill offers.

(2) *Routes of communication.*—Routes of communication include the road net available for tactical maneuver and supply, rail facilities, navigable waters, and potential airplane landing fields, all of which must be considered in protection against chemical attack. These are all targets not only for enemy bombardment but also for chemical attack. If chemicals are laid down by hostile troops upon routes of communication, delay will be caused and much matériel rendered unfit for use. Defenses must be planned in advance against the use of both nonpersistent and persistent agents. Alternate positions and routes of approach must be selected and cover sought to minimize the result of enemy chemical attack.

c. Effect of ground surface upon use of chemical agents.—

(1) Soft dry ground will absorb liquids and thereby reduce danger from direct physical contact. It is difficult to detect vesicant gas, however, when absorbed by earth.

(2) On soft wet ground mustard liquid persists for considerable periods, free and unabsorbed. Where shell or bombs burst on such ground, a large proportion of the liquid content will be absorbed or buried in the crater, contaminating earth or mud.

(3) On hard ground the liquid contents of chemical projectiles are scattered over a relatively large area. Hard ground retards penetration of liquid agents released in this manner, and consequently the agents are exposed in greater degree to the influence of wind, sun, and rain, thus lessening their persistency.

■ 16. VEGETATION AND STRUCTURES.—*a. Effect of wooded and bush-covered areas.*—Although wooded sections furnish bivouac and assembly areas, they also become ideal targets for enemy chemical attack. When there is a possibility of chemical attack, alternate positions must be selected for occupancy in the event that initial locations become untenable due to hostile use of chemicals. Heavy woods free of underbrush furnish good cover from airplane spray attacks of vesicant agents. However, due to the vapor hazard, masks must be worn by troops during the time that they are in such woods. Assembly areas are excellent targets for surprise shoots of nonpersistent agents such as phosgene. Persistent agents may also be used on them. Before entering such an area, advance parties should make a thorough reconnaissance to determine whether the area previously has been subjected to persistent agents. In wooded or bush-covered areas, agents remain for a long time.

b. Effect of tall grass.—Tall grass will tend to slow down the movement of gas and smoke clouds and will produce a great "drag effect" upon such clouds. This will mean that nonpersistent agents will remain in contact with personnel on grass-covered areas a longer period of time than on open areas. If areas covered with tall grass have been recently contaminated with vesicants, the hazard of crossing them is increased as drops of liquid on the grass will come in contact with clothing as well as vehicles.

c. Effect of buildings.—Buildings normally will furnish a limited degree of protection from chemical attack, but they may increase the dangers attendant to such an attack. When boots or shoes become contaminated with liquid mustard gas and are later worn in inclosed places, dangerous vapor concentrations may arise. Also, the enemy, in vacating a building or a town, may contaminate the inside of buildings with mustard gas or lewisite which in the inclosed

space will produce casualties even if the concentration appears to be very low.

SECTION IV

WEAPONS AND TACTICS

■ 17. METHODS OF PROJECTING CHEMICAL AGENTS.—The use of chemicals in warfare, and of weapons and munitions to project and disperse them, will vary in number and type with combatant forces. Not all nations may be expected to employ always the same agents, nor to employ them in precisely the same way. In general, however, agents will usually be projected or dispersed by the following methods:

- a. From artillery shell and mortar shell.
- b. From chemical projector shell.
- c. From aircraft, either in chemical or incendiary bombs, or as spray.
- d. From cylinders or gas candles in the form of a cloud.
- e. From hand grenades.
- f. From bulk containers and chemical land mines placed in position and fired statically.
- g. From vehicles in the form of vesicant spray to contaminate ground.

■ 18. TYPES OF ATTACK.—Hostile forces may employ the following types of chemical attack:

- a. A concentrated shell attack of short duration upon densely occupied areas with nonpersistent gas for the purpose of inflicting casualties by surprise.
- b. Harassing fire at a slow rate with shell containing nonpersistent or moderately persistent chemical agents, such as lung irritants, lacrimatory, or certain vesicant agents. This harassing fire may continue for several days and then be followed by a casualty shoot.
- c. Neutralization with highly persistent gas to render areas untenable and to inflict casualties upon personnel occupying them. Vesicants are the type generally used for this purpose.
- d. Smoke screens to blanket observation, prevent aimed fire, and screen troop movements.
- e. With incendiaries to set fire to stores, structures, and vegetation, and to inflict casualties.

- f. Spraying with persistent agents from an airplane.
- g. Cloud gas attacks for either harassing or casualty effect.

■ 19. HOW TO RECOGNIZE SIGNS OF AN IMPENDING CHEMICAL ATTACK.—If the enemy is planning to release gas by means of cylinders or projectors, the preparations for the attack will in all probability be made at night and, in most cases, the noise of metallic cylinders colliding can be detected. Also, an occasional odor of gas may be detected from shells or cylinders being opened by bursts from our artillery fire. Information received by our intelligence service may reveal plans for such an attack. If meteorological and terrain conditions favor such an attack, all precautions should be taken in advance to minimize casualties and protect matériel. A chemical shell containing a liquid can sometimes be distinguished from other shell by the peculiar intermittent whirring noise it makes in flight and usually by its low detonation sound.

■ 20. CHEMICAL ARTILLERY AND MORTAR SHELL.—*a. Gas shell.*—

(1) Use of gas shell is in a large measure independent of wind direction, though not of wind velocity. Persistent agents of the mustard gas type are suitable for projection from light artillery and mortars. Nonpersistent agents of the phosgene type are suitable for projection from medium artillery and mortars.

(2) Before an attack only nonpersistent gases are likely to be used on the area over which the attack is to be made, although persistent agents may be used on adjacent areas or rear installations.

(3) Chemical content of artillery shell is small when compared by weight with other chemical containers. To produce an appreciable effect, chemical artillery shell must, therefore, be used in large numbers.

(4) The agents most likely to be projected by 75-mm shell are those of high persistency. Liquid agents are thrown over an area about 6 yards in diameter. Those most likely to be projected by the 105-mm and the 155-mm shell are mustard gas, lewisite, and phosgene. Upon explosion of the 105-mm shell, liquid agents are dispersed over an area approximately 10 yards in diameter. The 155-mm shell, on bursting, distributes liquid over an area approximately 15 yards in diam-

eter. The 4.2-inch chemical mortar shell will disperse liquid agents over an area approximately 12 yards in diameter.

b. Smoke shell.—Artillery and mortar smoke shell used for training purposes in the Army are filled with FS, while the smoke filling for standard use is WP. White phosphorus is used as standard filling in the 75-mm, 105-mm, and 155-mm artillery shell, and in the 81-mm and 4.2-inch mortar shell. Bursting shell filled with white phosphorus distributes the agent over the following area diameters: 75-mm, 15 yards; 105-mm, 40 yards; 155-mm, 50 yards; 81-mm mortar, 20 yards; and 4.2-inch mortar, 40 yards.

■ 21. CHEMICAL PROJECTOR SHELL.—*a.* By means of chemical projectors a large amount of gas can suddenly be set free. Clouds produced are of higher concentration than can be obtained in the field with any other chemical projectile.

b. A Livens projector is a simple mortar designed to fire only one shot per installation. Projectors are usually installed in batteries of 25 and fired simultaneously by an electric current (fig. 5). Usually many batteries are fired at one time against one target.

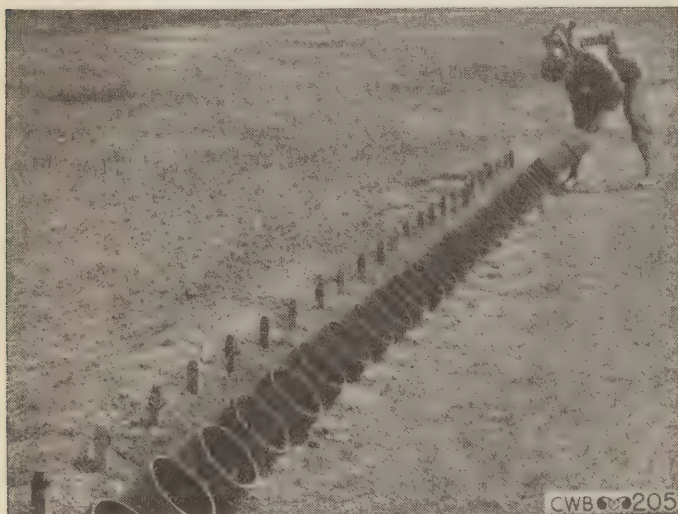


FIGURE 5.—Livens projector installation.

c. Nonpersistent casualty agents are usually employed in these shell. However, highly persistent and high-explosive agents may be projected in them. An enemy may launch a projector attack in two salvos, the first being HE to produce casualties among men above ground and cause momentary confusion, and the second being a nonpersistent gas to reach men below ground and produce additional casualties during the confusion caused by the first salvo.

d. Phosgene is the agent most likely to be used in chemical projector shell. The explosive charge in this shell is only slightly greater than that necessary to rupture the shell body. Agent from a single Livens shell is thrown over an area about 20 yards in diameter. The shells from a single battery of 25 projectors concentrated upon a single point will scatter over an area about 320 yards in depth and 240 yards in length. The gas cloud will completely cover this area in 30 seconds. Prompt adjustment of the gas mask and the wearing of it until the gas moves out of the area fulfills the requirements for protection. Danger areas also extend down wind in much the same way as explained in the case of nonpersistent agents projected by artillery or mortar shell. These areas usually extend several thousand yards down wind from the impact zone.

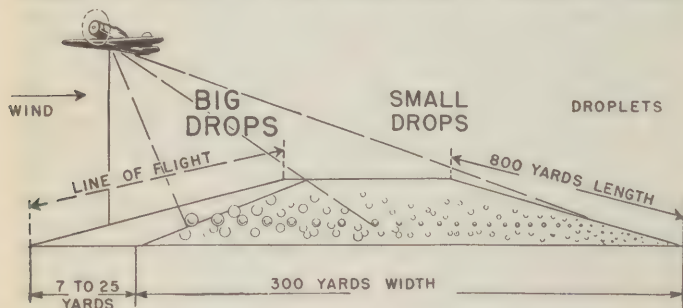
e. Indications of the installation of projectors by an enemy may be obtained from airplane photographs. However, projectors can be installed and fired in one night. Projector attacks can generally be recognized by a huge flash or a series of flashes immediately followed by a loud explosion. These shells make a peculiar whirring sound in flight and a subdued explosion when they burst.

f. If fired in daylight, chemical projector shell can be seen in the air. This projectile is usually fitted with a fuze burning from 30 to 36 seconds. If the loud explosion of the propelling charge is promptly recognized as a chemical projector attack, there is a short period of time in which to give the alarm and adjust gas masks before the gas begins to spread over the target area.

■ 22. AIRPLANE CHEMICAL BOMBS.—Aerial bombs may be used to disperse chemical agents of varying persistency as well as smoke and incendiaries. When flying at low altitudes, air-

planes have the ability to launch surprise attacks on unsuspecting personnel. Smoke-laying airplanes can establish smoke screens permitting other aircraft equipped with chemical bombs or spray apparatus containing chemical agents to reach their targets unobserved and protected against hostile fire. The agents most likely to be dispersed from chemical bombs are mustard gas, lewisite, and white phosphorus. The explosion of a 30-pound bomb upon impact throws liquid agent over an area approximately 40 yards in diameter and WP about 80 yards in diameter. Aerial bombs of 100 pounds or larger may be used to discharge either persistent or nonpersistent gases. Action of agents thus released is similar in principle to the action of agents discharged from projector shell and necessitates corresponding protective measures.

■ 23. AIRPLANE INCENDIARY BOMBS.—Airplanes are capable of carrying large numbers of incendiary bombs (par. 7g), since their individual weight is small. Incendiary bombs of the magnesium type usually weigh less than 4 pounds. Assuming that the average weight is 3 pounds, then an average bomber can carry approximately 1,500 such incendiary bombs, usually in clusters. Of the 1,500 bombs dropped on a large town, the probability is that only one out of a dozen will lodge on a flammable target and start a fire, or 125 fires would result over the strip traversed by the bomber. Although the number of fires started may be rather low when



CWB 206

FIGURE 6—Airplane spray—size of drops.

compared to the number of bombs dropped, the total destructive power of such an attack is considerable.

■ 24. AIRPLANE CHEMICAL SPRAY.—Attacks by this means are primarily directed against personnel.

a. High altitude spray.—Airplanes are capable of dispersing high altitude sprays of large droplets if a viscous form of vesicant agent is employed. This method of spraying is for use against general and not specific targets.

b. Low altitude spray.—When specific targets are to be attacked, low altitude spray is employed. The agents most likely to be used for spray attacks are mustard gas, lewisite, and any type of liquid smoke. Aircraft flying at an altitude between 50 and 1,000 feet can lay a belt of persistent gas in an effective concentration on the target. The actual length of the area covered will depend upon the capacity of the tank, the rate of discharge, and the speed of the airplane. The actual width of the area covered will depend upon the agent, wind velocity, altitude of the airplane, and the course of the airplane in relation to wind direction and velocity. The belt will be wider when the airplane flies at right angles to the wind than when it flies parallel to the wind. The drops will be larger on the up wind side, gradually getting smaller down wind across the target.



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FIGURE 7.—Airplane spray attack.

■ 25. AIRPLANE SMOKE SCREENS.—The quickest method of laying a smoke screen is by means of airplane spray tanks. The same type of tank that is used to spray vesicant agents can be employed for laying smoke. FS is the agent generally used, although titanium tetrachloride (FM) may be employed. Such an aerial smoke screen dissipates rapidly and can be maintained only by repeating the process or by ground reinforcement of the screen. The smoke-laying airplane may be followed by more airplanes spraying vesicant agents.



FIGURE 8.—Airplane smoke screen.

■ 26. CHEMICAL CYLINDERS AND IRRITANT CANDLES.—Chemical cloud attacks are dependent upon suitable wind direction and velocity. Characteristic features of a cloud attack are pervasiveness and duration. The gas liberated from cylinders or candles may be carried effectively along the surface of the ground by the wind for several miles, depending upon the number of munitions used and weather and terrain factors. Gas clouds may be released from concealed cylinders or candles or from cylinders mounted on special vehicles.

a. Chemical cylinders.—The discharge of gas from cylinders may be made either by day or night. At the moment of discharge some warning may be given by the hissing of gas escaping from the cylinders. The clouds are initially white from condensed water vapor, but the actual location and width of the front may be disguised by the liberation of smoke. Only nonpersistent gas is used in cloud gas attacks, but this may remain for an hour in thick woods or even longer in dugouts or shelters. Phosgene is a suitable agent for use in this weapon.

(1) Portable cylinders filled with chemical agents are carried into position on the backs of soldiers. Special type nozzles have been developed to release the gas rapidly and with a minimum of hissing.

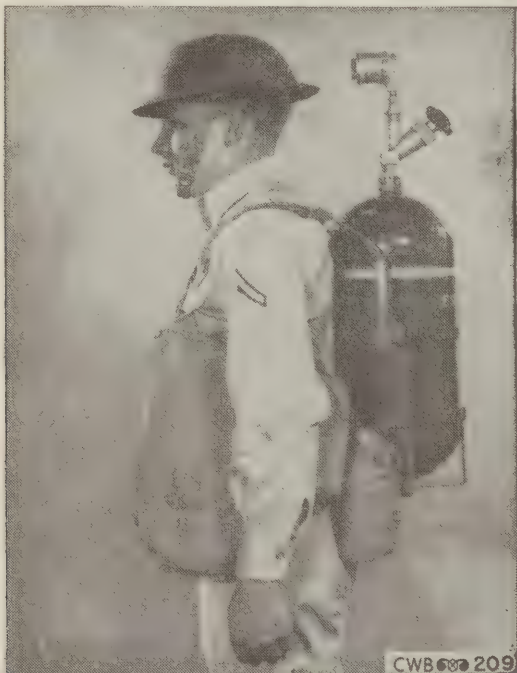


FIGURE 9.—Chemical cylinder in carrying position.

(2) Large numbers of cylinders may be released while loaded on trucks or railroad cars. Valves on cylinders may be constructed so as to be opened electrically.

b. Irritant candles and generators.—(1) Adamsite is the principal agent used in irritant candles or irritant smoke generators. This agent when dispersed from candles produces a canary yellow smoke which causes sneezing and vomiting. Favorable wind conditions are necessary to carry the agent to the target. It is very effective in serious civil dis-



FIGURE 10.—DM candle in operation.

turbances, and in combat may be used prior to or in conjunction with a nonpersistent agent such as phosgene, in which case advantage is taken of its nauseating effect to cause personnel to remove their masks with resulting exposure to the phosgene. Adamsite is distilled by the heat from burning smokeless powder. The candles may be ignited either manually or electrically.

(2) Chloracetophenone can also be dispersed successfully from candles or pots. These munitions are ignited either singly or in series. The average burning time of a single

CN pot is 3 to 4 minutes. They may be ignited either manually or electrically.

■ 27. **CHEMICAL GRENADES.**—Hand grenades filled with irritant agents are used to force personnel to evacuate dugouts and inclosed spaces. The agents used in grenades are CN (tear gas), CN-DM (tear gas and irritant gas), and HC (smoke). The HC grenade is standard for the Army Air Forces only. Chemical grenades burn and do not burst. Grenades are capable of full gas production from 2 to 3 seconds after being thrown, and burn for 25 to 40 seconds.



FIGURE 11.—Chemical hand grenades.

■ 28. **CHEMICAL LAND MINES.**—Chemical land mines are metal containers, generally of one gallon capacity, filled with either a liquid or a solid agent. The contents are dispersed by a burster charge placed under the mine, which is fired electrically or by means of a time fuze. Containers may be filled with HS, WP, FS, or simulated HS. Each HS mine effectively contaminates an area having an average diameter of from 15 to 25 yards, depending upon the type and amount of burster charge employed. Land mines are used only on

ground likely to be occupied or traversed by the enemy, such as wooded areas, stream crossings, bridge heads, road blocks, demolitions, and roads, or the front or flanks of a defensive position or on similar areas in retrograde movements.

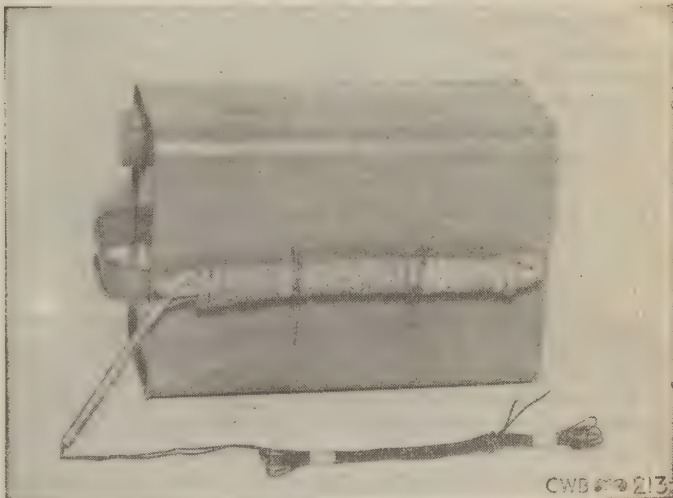


FIGURE 12.—Chemical land mine with burster attached.

■ 29. SPRAY DEVICES.—Vesicant agents may be sprayed from vehicles, tanks, or hand pumps. The personnel engaged in this task must be thoroughly protected against contamination.

■ 30. DANGER AREA.—*a.* A danger area extends down wind from the point of dispersion of any chemical agent. The extent of this area depends upon the persistency of the agent, the munition employed, the temperature, the wind direction and velocity, and the terrain. The liquid from a nonpersistent gas shell changes almost instantly to a gas upon the detonation of the shell, whereas with a persistent agent, only a portion of the liquid is vaporized immediately.

The remainder is dispersed over the ground and slowly changes to a gas, the rate of change depending upon the

temperature. Until vaporization is complete, there continues to be a dangerous area down wind. However, the concentration is much lower and the effective distance down wind much less than that immediately following the burst. The distance down wind that a persistent gas will be effective is considerably less than that of a nonpersistent gas. For example, a single large-caliber shell containing a nonpersistent agent will create a danger area to a point approximately 300 yards down wind. A similar shell containing a persistent agent will do this for a distance of approximately 200 yards.

b. Projector attacks over a wide front with nonpersistent agents will cause areas up to several miles down wind to be dangerous, whereas 1,000 yards or more down wind would be the danger area set up by a persistent agent.

c. The danger area from nonpersistent agents released from cylinders, grenades, or toxic smoke generators depends upon weather conditions and the number and kind of munition employed.

d. In addition to weather, terrain, and the agent, the following factors enter into the extent of a danger area when airplane chemical spray is used: speed and altitude of the airplane, direction of the airplane with respect to the wind, and the rate of discharge. (See par. 24.)

■ 31. PROTECTIVE MEASURES.—Protective measures will differ slightly, depending upon the physiological type of gas encountered.

a. In the case of a lung irritant gas, such as phosgene, the proper measures are to stop breathing until the gas mask is correctly adjusted and to continue wearing the mask until the gas concentration has dissipated. The time of wearing the gas mask will vary. Normally the agent from a single shell will last about 10 minutes, but if a bombardment is continued, the danger time is increased. Weather and terrain conditions at the defender's position may also greatly extend the effective time of this type of agent.

b. For the vesicant gases the protective measures include not only the prompt adjustment of the mask, but also the proper wearing of protective clothing. It must be remembered that persistent vesicants such as mustard gas and

lewisite in the vapor state will affect eyes and skin and will injure lung tissue. In the liquid state these vesicants may be absorbed directly by the clothing and thence transferred to the skin, or absorbed by vegetation, wood, and concrete, or may adhere to metal equipment from which vapors may be given off, or unnoticeable quantities of liquids may be transferred to the hands and thence to other parts of the body. Many blisters may be caused by this transference. If clothing and equipment become contaminated, appropriate measures include the prompt removal of such articles, the thorough cleansing of the body with soap and water, and the decontamination of the infected articles before they are again used. A portion of the liquid agent will remain in the area of burst for several days, and during such time it will be dangerous for any person to enter this area unless completely protected with protective clothing.

c. Gas sentries should be posted and continued whenever the situation warrants, and a thorough system of warning established to offset the use of the principle of surprise often associated with chemical attack. The sound of the gas alarm should be so distinctive and well understood by personnel that actions and thoughts following an alarm will become automatic and routine.

CHAPTER 2

PROTECTION

	Paragraphs
SECTION I. General.....	32-33
II. Individual.....	34-35
III. Collective.....	36-41

SECTION J

GENERAL

■ 32. CLASSIFICATION OF PROTECTIVE MEASURES.—Protection against chemical attack presents three classes of problems: individual, collective, and tactical. The first two involve principally the provision and use of protective equipment and installations. The third concerns modes of action and troop leading with a view to avoiding gas casualties in the conduct of military operations.

a. Individual.—Individual protection includes the proper distribution and care of individual protective equipment; the ability to recognize the presence of a particular chemical agent; the ability to utilize protective equipment in such manner that injury is avoided; and the ability to apply first-aid measures.

b. Collective.—Collective protection is the utilization of measures and unit protective equipment for the protection of personnel, animals, and matériel. It includes—

- (1) Operation of gasproof shelters.
- (2) Posting of gas sentries.
- (3) Measures to insure the preservation of animals and equipment.
- (4) Use of protective covers.
- (5) Decontamination of matériel.
- (6) Organization for protection, such as the appointment of unit gas officers and gas noncommissioned officers.
- (7) Use of an alarm system.

c. Tactical (see ch. 4).—"Tactical protection" is the term used to designate the disposition of troops in combat and

the security measures taken to avoid or greatly reduce the number and severity of gas casualties and to minimize the chances of contamination of supplies and equipment. It includes such activities as—

- (1) Chemical reconnaissance.
- (2) Chemical intelligence.
- (3) Selection of routes of march, camp sites, assembly areas, and battle positions.
- (4) Protective disposition of troops.
- (5) Schemes of deployment of units.
- (6) Maneuvers to avoid gassed areas.
- (7) Offensive action to forestall or disrupt enemy chemical operations.

■ 33. BASIS OF ISSUE OF PROTECTIVE EQUIPMENT.—Items of equipment for defense against gas attack are issued in conformity with Tables of Basic Allowances and Tables of Allowances for posts, camps and stations.

SECTION II

INDIVIDUAL

■ 34. OPERATION OF GAS MASKS.—The gas mask protects the soldier's eyes and respiratory tract from chemical agents encountered in the field.

a. Principle of operation.—The principle of operation of the gas mask is based upon air filtration (fig. 13). Air is drawn into the mask when the individual inhales, the mask being so constructed that the air must pass first through a canister containing a filtration system. This comprises a mechanical filter to prevent the entrance of smoke or dust, and a filter of charcoal and soda lime to absorb and neutralize toxic and irritating gases and vapors. After being purified, the air is drawn into the facepiece and, after being inhaled and exhaled, is expelled from the mask through an outlet valve.

b. Types of gas masks.—Five types of war-purpose gas masks are in use, all of which function as described in *a* above. These are the service, diaphragm, training, and optical mask for use by the Army, and the noncombatant mask for civilians. For a detailed description of Army gas masks, see TM 3-205. Gas masks, as issued, will give full

protection against lung irritants, irritant smokes, and lacrimators in concentrations likely to be encountered in the field. They will not protect against gases encountered in industry such as carbon monoxide and ammonia gas.

(1) *Service gas masks* will protect against all agents likely to be encountered under field conditions. A tube of antidim

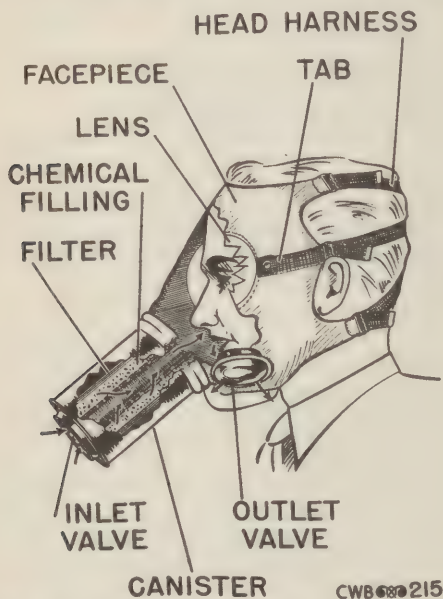


FIGURE 13.—Noncombatant gas masks—sectional view.

compound is included in the carrier, and if applied in a very thin film to both sides of the eyepiece (par. 109), will assist in preventing fogging by moisture in the mask and from rain. The canister is carried in a carrier under the left arm and is connected to the facepiece by a noncollapsible rubber hose.

(2) *Diaphragm gas masks* are issued to officers, noncommissioned officers, telephone operators, and others whose duties require audible speech. This mask is similar to the

service gas mask except that a diaphragm is placed in the facepiece beneath the eyepieces.

(3) *Training masks* have been developed for the purpose of supplying the Army with a cheap and lightweight mask for training purposes. It differs from the service mask in weight, shape, and size of the canister and carrier. The training mask is essentially a snout-type mask.



① Training mask. ② Service mask. ③ Diaphragm mask. ④ Optical mask.

FIGURE 14.—Gas masks.

(4) *Optical masks* are issued to officers and enlisted men whose duties require the use of optical instruments such as range finders or binoculars. The eyepieces are small, flat, and in the same plane so that no light can penetrate to the eyes except through the instrument employed at the time. The facepiece is equipped with a diaphragm assembly for communicative purposes. The canister is located at the back of the neck.

c. Special masks and canisters.—(1) *Noncombatant mask.*—Noncombatant masks are of snout-type construction and give the same degree of protection as the Army training mask. The canister is fastened directly to the facepiece, and the cellulose acetate eyepieces are sewn into the facepiece (fig. 13). These masks are designed in four facial sizes: for large and small adults, and for large and small children.

Noncombatant masks should not be given to children less than 4 years of age.

(2) *Infant respirator*.—Babies and small children may be protected by an "infant respirator" consisting of a hood and coat combined in one garment. It incloses the head, shoulders, and arms, and is closed at the waist by a drawstring, thus enabling the baby to get its hand to its mouth. Ample vision for mother and baby is provided by a large window. Air is supplied through an outside canister by means of a bellows, which must be pumped regularly. These respirators are designed to include a separate carrier to fit the back of an adult. The garment is large enough for children up to 6 or 7 years of age. This respirator is also of the box-type construction.

(3) *Dust respirators*.—Commercially manufactured dust respirators are supplied personnel driving motor vehicles and tanks for protection against dust only and not against gas or irritant smokes.

(4) *Special canisters*.—Canisters supplied with any type of Army gas mask will protect against concentrations up to 1 percent by volume of any of the known warfare toxic gases or smokes, but will not protect against industrial gases such as carbon monoxide or ammonia. For these latter gases special canisters are manufactured similar in size and shape to the service canister. The following special canisters have been developed by the Chemical Warfare Service: acid vapor, all-purpose, ammonia, HCN, and oil vapor.

(a) *Acid vapor*.—This canister is painted white and protects against vapors such as the fumes of acetic and formic acid, and also against sulfur dioxide, chlorine, and oxides of nitrogen.

(b) *All-purpose*.—This canister is painted red. Protection is afforded for a limited time against acid vapors, vapors of organic solvents such as benzene, chloroform, ether, and formaldehyde, and against carbon monoxide gas.

(c) *Ammonia*.—This is a green canister affording protection against concentrations of ammonia which might be encountered in a refrigeration plant.

(d) *HCN*.—Hydrocyanic acid canisters are painted white and protect against concentrations of HCN which normally are used in fumigating buildings or ships.

(e) *Oil vapor*.—This canister affords protection against oil vapors and also against the fumes of organic solvents such as carbon bisulfide, carbon tetrachloride, and ether. It is painted black.

■ 35. PROTECTIVE EQUIPMENT.—*a. Clothing*.—Protective clothing, designed for the protection of the body against agents of the vesicant type, is available for personnel engaged in handling vesicant agents or in decontamination. Two types are in use, the impermeable and the permeable. Either type is designed to cover the entire body. Hoods are provided to cover the head and shoulders (par. 114). The gas mask is required for the protection of the face and respiratory system.

b. Ointment.—A special ointment is available for the protection of the skin against vesicant agents (par. 126).

c. Shoe impregnite.—Issue shoes may be rendered resistant to vesicants by the application of shoe impregnite (par. 117).

d. Soap.—As an added protective measure each soldier should carry a piece of soap on his person when in the danger zone, to be used with water as described in first-aid procedures.

SECTION III

COLLECTIVE

■ 36. ALARMS.—There are two classes of alarms given when an enemy gas attack occurs, general and local.

a. General.—General alarms are given only in the case of cloud gas attacks that are expected to involve a large area. They are sent out by all normal methods of communication and are directed to all localities that may be affected.

b. Local.—Local alarms are given in all cases in which the presence of gas is recognized. They are usually given only with alarm devices which, when struck rapidly and continuously, produce a sound not easily confused with other sounds encountered in combat. Improvised alarm devices of this type may include bells, metal triangles, iron rails, pipes, or empty 75-mm or 105-mm shell cases. All personnel should be informed what type is to be used and become familiar with its distinctive sound.

■ 37. GASPROOF SHELTERS.—*a. General*.—(1) It is possible to subject extensive areas to lethal concentrations of toxic gas

for periods varying from a few minutes to several days. Masks and protective clothing are sufficient protection against such concentrations but they cannot be worn indefinitely. Troops which must remain in gassed areas require gasproof shelters in which to rest, eat, and sleep. Shelters are also necessary for medical stations, telephone stations, and in some observation posts, command posts, and for other activities where efficiency is unduly impaired by wearing a gas mask.

(2) All gasproof shelters should have a gas sentry near the entrance. The duties of this sentry are set forth in paragraph 40b. All gasproof shelters should be provided, with a sign in a conspicuous place on the building giving the following information:

(a) That it is a gasproof shelter (ventilated or unventilated).

(b) Capacity of shelter.

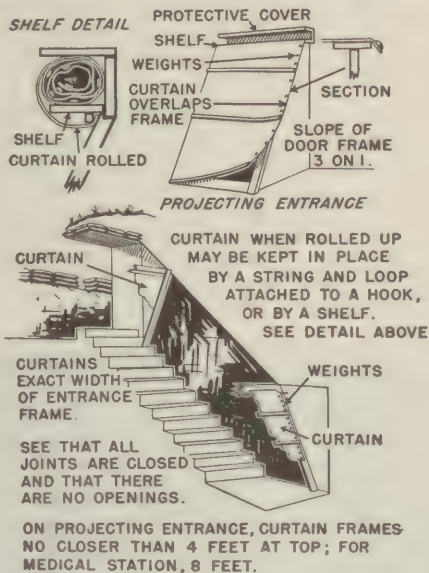
(c) Length of time that the specified number of men can remain in the shelter.

b. Location.—Gasproof shelters should be so located that they take advantage of any natural protection from direct wind paths. Terrain greatly affects the movement of a gas cloud, especially in a wind of low velocity. High hills and deep valleys deflect gas from the general direction of the wind. Whenever possible, shelters should be located where heavy concentrations of gas will not form.

c. Construction.—(1) *General.*—There are three types of gasproof shelters: unventilated field shelter, ventilated field shelter, and ventilated permanent gasproof installation. The unventilated shelter can be a dugout, a bombproof or ordinary stone, brick, or wooden building above ground. This is made gasproof and provided with an air lock. The important consideration in making a shelter gasproof is the elimination of all drafts. Special types of entrances are used which consist of a system of double doors of hung gasproof curtains which, when dropped, rest on slanting frames, the outer frame slanting outward and the inner slanting inward, forming an air lock. Whenever possible the entrance to a gasproof shelter should be a walled-in passageway or tunnel several feet beyond the walls of the shelter, with the ends slanted, at an angle of three on one. The door frame is made

preferably from 1- by 6-inch boards at the sides, and by 1- by 4-inch boards at the top and bottom (fig. 15).

(2) *Curtain doors*.—Curtain doors may be constructed by cutting a blanket to the proper size (about 4 inches wider and longer than the door frame). Slats are nailed horizontally at intervals across the inside and outside of the curtain to



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FIGURE 15.—Entrance to gasproof shelter.

hold it in place when lowered and to keep it pressed against the frame. Inside slats must be about 2 inches shorter than the width of the opening of the door frame. The top end of the blanket is then attached to the top of the slanted door frame. Nails, nuts, bolts, or other weights are used at intervals from top to bottom and close to the edges of the curtain and outside of that part which falls on the door frames. When the curtain is lowered, the weights hang over the edge of the frame and pull the edges of the curtain with them,

thus forming a flap which keeps the curtain pressed against the frame. A standardized gasproof curtain is provided for organizations in the field. This consists of a blanket equipped with an outer covering of impermeable fabric with slats and weights attached.

(a) *Shelf for door when left open.*—When not in use, the curtain door is rolled up and the roll is placed on a shelf above the top of the frame (fig. 15). If necessary, a metal or wooden visor is nailed over the shelf to protect the curtain from sun and rain.

(b) *Functioning of double-door system.*—When lowered into place the two doors make the shelter gasproof by forming an air lock between them. To enter the outer door, one side of the curtain on the down wind side is pulled away from the frame just far enough to permit entrance (fig. 16). The person then enters the air lock and closes the outer door behind him before opening the inner door. When leaving the shelter the reverse procedure is followed.



FIGURE 16.—Entering gasproof shelter.

(c) *Proper distance between doors.*—When the entrance to the shelter is a simple horizontal passage, the doors are placed at an average distance of 6 to 9 feet apart. If the entrance is a stairway, one door is placed at the head of the stairway and the other at the foot where there is a horizontal passageway for a few feet. If the stairway enters directly into the room, the two doors are placed at intervals on the stairway with both slanting outward. In case of a dressing room, the space between the doors must permit stretcher bearers to bring in a stretcher without opening both doors at once.

(d) *Modification in construction.*—Where the entrance is not a projecting passageway, as described in (3) above, modifications in the construction of the gasproof curtain doors must be made. In any case the same principles should be observed.

d. *Preparation for use.*—Prior to use, the room or building should be made as nearly airtight as possible. When an old building is used the windows and large cracks should be chinked with mud, rags, paper, or any suitable material available. Large openings such as shell holes can be closed with blankets or standardized gasproof curtains. Both gasproof curtain doors are lowered, all ventilators closed, and all fires extinguished. Fires use up the oxygen, draw in air from the outside, and give off the odorless poison gas, carbon monoxide. A supply of chloride of lime should be in the shelter. This is spread around between the doors at the start of a gas attack or placed in a box at the entrance. It will neutralize any liquid agent which might adhere to the shoes of men coming from contaminated areas.

e. *Ventilation.*—Persons entering a shelter during a gas attack will always bring in traces of gas on their shoes and clothing. This is especially dangerous in the case of mustard gas, as an effective concentration entirely imperceptible to the occupants may gradually be built up. In dugouts or shelters intended to be used for a considerable time, collective protectors (par. 38) obtained from the chemical officer should be installed. After a gas attack a contaminated shelter may be cleared of gas by opening the doors and building a fire inside. The length of time a gasproof shelter can be occupied without ventilation may be estimated by apply-

ing the rule that a man at work requires at least 3 cubic feet of air per minute; more is desirable.

f. Capacity.—(1) In considering the volume of air required in shelters it is necessary to take into account many variable factors influencing the maintenance of normal life functions. These factors are numerous and so impossible to compute in the field that it is not feasible to find exactly the amount of air a man needs. But it is assumed that 1 cubic foot of air per minute per man is enough to sustain life of a person at rest and mentally at ease. From this point on the demands for air are increased according to the influence of the above mentioned factors. A table is supplied in appendix I in which suggested volumes of air and space requirements are furnished. In considering this table it is wise to allow considerable tolerance in the figures given to take care of the variables involved. It is better to err in the direction of too much air per person than too little.

(2) The size of the shelter and the number of occupants assigned to it are controlling factors, for the heat is not dissipated as readily in a large shelter as in a small one, due to the variation in the ratio between wall surface and volume. More space per person is needed for this reason in larger shelters. In gastight, unventilated structures, physical distress would normally take place from excessive humidity and temperature before a shortage of oxygen or an increase of carbon dioxide would affect the individual. To dissipate the excess heat and moisture is more of a problem than to supply fresh air.

(3) The following rule-of-thumb for calculating the capacity of small shelters may be applied in the field. Capacity for small shelters (not over 12 men):

(a) Initial air space requirement—150 cubic feet of air per man.

(b) Minimum air requirements—1 cubic foot of air per man per minute, if men are at rest. For example, a building 10 by 10 by 10 feet divided by 150 would accommodate 6 men who could remain for approximately $2\frac{1}{2}$ hours.

(c) For men engaged in light work such as operating a telephone switchboard, the air requirement should be ap-

proximately 3 cubic feet per man per minute. In the above example the men could remain approximately 1 hour.

$$\frac{10 \times 10 \times 10}{6 \times 3} = 55 \text{ minutes.}$$

■ 38. VENTILATED SHELTERS.—For the construction of a ventilated gasproof shelter in the field, a dugout, a bombproof or a stone, brick, or wooden building above ground can be utilized. These structures are first made gasproof and then provided with air locks and a collective protector. Since men in these installations would continue to work during a gas attack, air requirements should be a minimum of 3 cubic feet of air per man per minute.

a. Collective protector.—(1) This item of equipment is issued for use at gasproof command posts, plotting rooms, and aid stations, intended to be used for a considerable time and where air may, in a short time, become foul or deficient in oxygen during a gas attack. It consists of an air blower mounted near a large canister and several feet of flexible pipe (fig. 17). The collective protector should be used only in an inclosure that has been made reasonably airtight. The entrance should be of the "gas lock" type with standardized gasproof curtains.

(2) Collective protectors are set up outside the room or inclosure to be protected and the pipe run inside. Since the concentration of gas is invariably greater near the ground level, the air intakes should be as high as is practicable to place them.

(3) When a gas attack starts, the collective protector is set in operation. Air from the outside is pumped through the canister, purified, and blown into the inclosure. A positive pressure of pure air is thus built up in the protected space which prevents the entrance of gas.

b. Permanent ventilated gasproof installation.—Shelters at a permanent installation such as a coast defense area or air base, should be not only bombproof but gasproof as well. These are equipped with the collective protector. All installations should be able to operate under normal conditions for an indefinite period, and should provide from 3 to 10 cubic feet of air per man per minute.

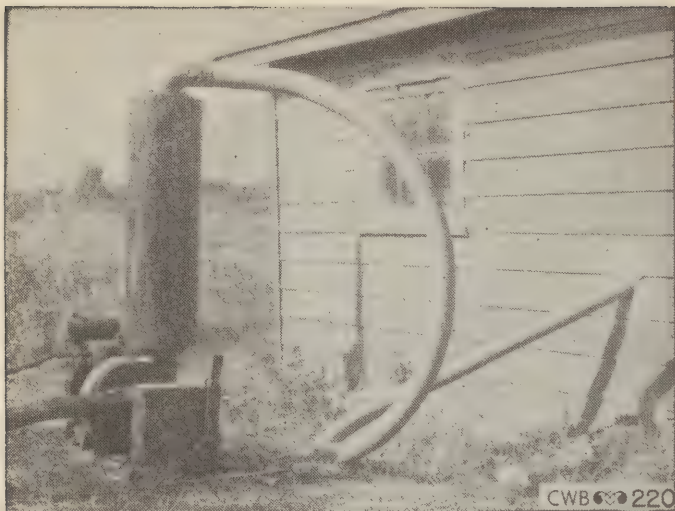


FIGURE 17.—Collective protector.

■ 39. GAS SENTINELS.—*a. General employment.*—(1) In the event of a gas attack, time is a vital factor. It takes only a short time to adjust the mask or place protective coverings over matériel. Gas sentinels are posted to give the alarm in ample time to enable this to be done. In the heat of an engagement, troops are likely to traverse contaminated terrain without being aware of the presence of gas. Hence, sentinels are posted to give warning to troops and thus forestall this contingency as much as possible.

(2) Alert gas sentinels are needed to watch for signs of impending gas attack and warn the personnel of their organization when such an attack occurs.

b. Duties.—A gas sentinel must—

(1) Enforce all specific orders of his post for defense against chemical attack.

(2) Locate the position of all sleeping men in his area.

(3) Detect sounds indicating the preparation for an actual enemy projection of chemical agents.

(4) Detect the presence of chemical agents by odor, color, or state.

(5) Give the alarm whenever gas is detected and awaken all sleeping men.

(6) Protect supplies in his area.

c. Procedure in event of a gas attack.—The gas sentinel will adjust his mask, sound the alarm, and immediately proceed to waken every man in his area. Gas sentinels will not pass on alarms arising in other areas but will give the alarm only when they themselves detect the presence of gas. This precaution is necessary in order to prevent the spreading of false alarms. In addition to their other duties, all sentinels will give the alarm whenever they detect the presence of gas.

■ 40. SPECIAL GAS SENTINELS.—*a. General duties.*—Special gas sentinels are usually posted to warn troops against dangerous gassed areas and to protect supplies at distributing points. They are placed on guard at the entrance to a gas-proof shelter. Their duties do not differ from the usual gas sentinels except that they are given special instructions regarding specific duties. Special gas sentinels on duty where supplies are stored should have protective clothing. Such installations may frequently be subjected to attack employing vesicant spray. The primary duty of these sentinels is to protect the supplies. Since such an attack develops rapidly, the gas sentinel has only a few seconds in which to put protective covers into position. He should, therefore, be in a state of readiness to act at an instant's notice. In case the enemy air attack includes incendiary bombs, he will give the prescribed fire alarm.

b. Duties at gasproof shelters.—A gas sentinel is always posted on the up wind side at a gasproof shelter. In the event of a gas attack he performs the following duties:

(1) Adjusts his mask and sounds the alarm to warn occupants of the shelter to close inner door or lower the gasproof curtain.

(2) Closes outer door or lowers gasproof curtain and assures its airtight adjustment.

(3) Sees that fires are extinguished inside shelter and that all ventilators and openings are closed gastight.

- (4) Looks after proper entrance and exit of personnel.
- (5) Requires personnel to carry out decontamination measures.
- (6) Observes that number of entrants does not exceed prescribed capacity of a shelter.
- (7) Directs starting and operation of collective protector at a ventilated shelter.
- (8) Sees that chlorinated lime is placed in the entrance of the gasproof shelter or in the air lock.
- (9) Opens door or raises the gasproof curtain for litter bearers at an aid station.
- (10) Tests for gas and advises occupants of a shelter when it may be opened after a gas attack.
- (11) After a gas attack, directs that airlock, and shelter if necessary, be cleared of any gas that may have entered.

■ 41. WARNING SIGNS.—When it is not practicable to decontaminate an area thoroughly, it should be posted on all approaches with improvised danger signs showing the agent involved and the date of contamination or its discovery. The signs should be posted far enough away from the area to give ample warning. When the area has lost its dangerous characteristics, the signs should be removed.

CHAPTER 3

ORGANIZATION FOR DEFENSE AGAINST CHEMICAL
ATTACK

Paragraphs

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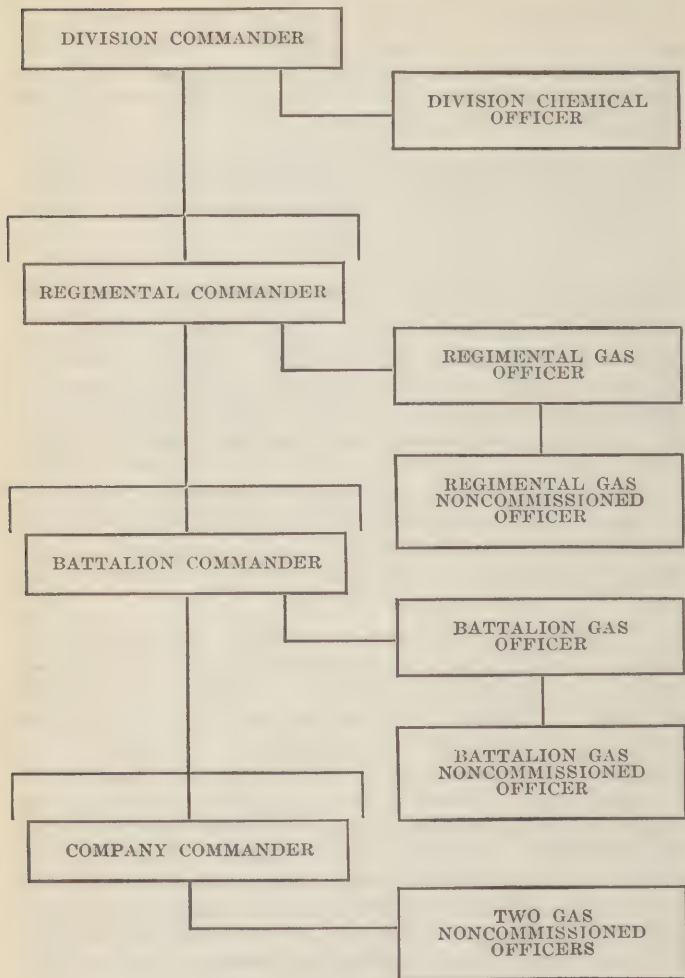
SECTION I

FUNCTIONS AND DUTIES OF VARIOUS STAFF OFFICERS

■ 42. RESPONSIBILITY OF COMMANDERS.—Organization commanders are responsible for the proper training of their respective commands in defense against chemical attack and, within the means available to them, are responsible for taking proper measures for the care and maintenance of protective equipment and for the protection of their troops, equipment, and supplies against gas. However, they have on their staffs specialists in defense against chemical warfare who advise them on the proper protective measures and who actively supervise the execution of all such measures under the authority of the commander.

■ 43. CHEMICAL STAFF OFFICERS.—Although the commanding officers of organizations are responsible for the training of their men in defense against chemical warfare, the chemical staff officer is responsible to his commander for the general supervision of chemical warfare training in all units of the command. It is the responsibility of the chemical staff officer to assist unit commanders in all matters pertaining to chemical warfare training and the supply of chemical warfare equipment. In time of war the chemical staff officer is charged with the collection and evaluation of chemical intelligence data as well as supervision of the training for active defense against chemical attack. In all cases the chemical staff officer acts in a supervisory and advisory capacity. He is an officer of the Chemical Warfare Service.

Organization for Defense Against Chemical Attack,
Infantry Division



■ 44. DIVISION CHEMICAL OFFICER.—*a.* The division chemical officer is an officer of the Chemical Warfare Service assigned to the staff of the division commander. He is the adviser to the division commander on all matters pertaining to chemical warfare and has four specific functions: protection against chemical agents, chemical warfare offensive operations, chemical warfare intelligence, and supply of chemical warfare equipment.

b. Under direction of the division commander and in co-operation with the G-2 section of the general staff, he gathers information of enemy chemical warfare activities either through the regimental or battalion gas officers or by direct means, transmits it to higher authority, and recommends to the division commander the issuance of such instructions to subordinate units as are necessary in each instance. He co-operates with the G-3 section in matters of chemical warfare training, recommends such procedure as is necessary in operations to insure defense against chemical attack, and exercises in the name of the commander a general supervision over all chemical defensive activities of the division.

c. It is a part of the duty of the division chemical officer to prepare a standing operating procedure for defense against chemical attack for his division. (See app. III.) Such a standing operating procedure should be prepared as soon as a newly mobilized division commences to function as such. These standing operating procedures apply to all routine measures of individual and collective protection which are independent of the tactical situation. He determines whether gassed areas are fit for occupation. In the event they are not, he posts them (par. 41) and warns the command of their location.

d. The division chemical officer is the division supply officer for chemical warfare items of protective equipment. In this function, through the division G-4, he requisitions chemical warfare supplies from the army and issues them to regiments and separate units within the division. Decontamination of ground, roads, buildings, installations, and equipment of immediate necessity for combat units is primarily a function of the units themselves. Such work is carried out under the supervision of unit gas officers. It is the duty of the division

chemical officer to arrange for the supply of the necessary decontaminating materials and equipment, and to render all possible technical advice to those concerned. In the case of a large contaminated area, the division chemical officer may be placed in charge of the entire work and such details of men and officers as are necessary to accomplish it being directed to report to him for orders. In the case of extreme urgency and need, the division chemical officer may initiate a request to army headquarters for army decontamination troops.

e. He will institute a chemical warfare school within the division and forward to unit commanders the names of men who have been trained in the school. He will constantly check on the gas discipline of his division.

f. The division chemical officer is consulted in the preparation of plans for any extensive use of chemical agents. He constantly keeps in touch with the situation with a view to aiding the plan of his commander by a judicious use of chemical agents by the supporting arms. He anticipates the use of chemical troops and advises the division commander of the desirability of requesting their attachment. He is responsible for the preparation of the plan for the use of chemical troops, which plan must be coordinated with plans of units to which the chemical troops are attached. He initiates chemical warfare operations for the division, but he does not command the chemical troops who carry out these operations.

g. He will maintain a situation map to keep informed of the general situation and the chemical situation. This map should not only show the gassed areas put down by friendly troops, but also gassed areas laid down by the enemy, the kind of agents used, and the date of contamination or discovery.

■ 45. AIR FORCE CHEMICAL OFFICER.—*a.* A chemical officer with the air force has the same general responsibilities and duties for chemical warfare supply and services as the chemical officer of other large commands. Specifically, he is responsible to the air force commander for—

(1) Preparation of plans for the supply of chemical warfare protective equipment to air force personnel, organization, and installation and provision of such bulk chemicals

as authorized for air force operations, such plans to include recommendations for the storage of those supplies to be maintained at air bases and operating airdromes.

(2) Execution of such plans through establishment of the necessary chemical warfare supply agencies at air force stations and general supervision of the operation of such chemical service units of detachments as may be assigned or attached to the air force command.

(3) Recommendations as to command, so far as it relates to operations of all chemical warfare personnel on duty with the air force command, not assigned to subordinate units thereof.

(4) General supervision of training of air force personnel in protection against chemical agents.

b. The air force chemical officer should be kept advised of all contemplated air force operations involving the use of chemicals or chemical warfare equipment in order that he may make timely provision for their supply.

c. In technical matters pertaining to chemical warfare the air force chemical officer is responsible for adherence to service policies promulgated by the theater commander.

■ 46. UNIT GAS OFFICERS.—Chemical staff officers are officers of the Chemical Warfare Service, while unit gas officers are members of the branch of the unit to which assigned. The latter are specially trained in gas defense schools by Chemical Warfare Service officers. They are responsible to their unit commanders for supervising all matters pertaining to chemical warfare training in their units. They keep informed as to the status of chemical warfare equipment in their units, cause such repairs to be made as are practicable within the units, and initiate timely requisitions to meet supply and maintenance requirements. In technical matters pertaining to their duties it is customary to permit direct communication between unit gas officers and the division chemical officer.

■ 47. REGIMENTAL AND BATTALION GAS OFFICERS.—a. Each regiment and battalion will have at all times a minimum of one unit gas officer and one gas noncommissioned officer who are qualified instructors, and each company will have a minimum of two gas noncommissioned officers. These officers and

noncommissioned officers are members of the arm or service represented and are detailed by their respective commanders, and unless otherwise directed, submit all reports to him. The work performed by them differs from that of the division chemical officer in that it is limited mainly to protection against chemical attack. The division of duties between the regimental and battalion gas officers varies with the unit or command of which the officer is a part. In some situations their duties may be so closely related that those performed by the regimental gas officer and the battalion gas officer will overlap.

b. The regimental gas officer will exercise general supervision over the battalions in training for defense against chemical attack, care and issue of protective supplies, and in the work of chemical intelligence and protection before, during, and after a gas attack. In general, the regimental gas officer supervises the battalion gas officers and takes care of supply functions, while the battalion gas officers have direct supervision of the training activities, gas defense measures, and gas discipline.

c. These officers are representatives of their unit commanders and have no function of command over his unit or subordinate units except as directed by the proper authority.

d. Following is a list of the more important duties of regimental and battalion gas officers:

(1) *General duties.*—(a) Insistence upon daily inspection of masks by troops at the front and upon weekly inspection by troops in rear areas.

(b) Inspection of gas sentinels to insure that they are familiar with their duties.

(c) Insuring that gas sentinels are posted over sleeping men and working parties.

(d) Insuring that gas sentinels are posted at entrances of gasproof shelters.

(e) Insuring that gas signs or sentinels are posted around contaminated areas to warn against entry by persons not equipped with protective clothing and gas masks.

(f) Frequent inspection and test of gas alarm devices.

(g) Inspection of gas noncommissioned officers, reporting those found deficient.

(h) Reporting by name, grade, and organization all persons violating orders for gas protection.

(i) Reporting all changes made in gas protective personnel.

(j) Reporting all chemical attacks, stating method of attack, size and number of projectiles, agent used, time of attack, location, weather conditions, casualties caused, and any other pertinent facts.

(k) Obtaining and forwarding to the rear for examination samples of enemy chemical agents not clearly identified, and samples of chemical warfare matériel captured or found.

(l) Frequent checking upon the condition and adequacy of all protective equipment and supplies.

(m) Meteorological observations and warning to the unit commander of weather conditions favorable to chemical attacks by the enemy.

(n) Supervision of decontamination activities.

(o) Recommendations concerning location and construction of gasproof shelters.

(p) Insuring that all attached units operating within their organization or area are properly trained, equipped, and inspected.

(q) Issuance of equipment and supervision of the training of a small detachment in decontamination methods.

(2) *Duties on the march.*—(a) Reconnoitering the route of march, and, if practicable before the movement is commenced, noting areas likely to be gassed.

(b) Advising in the selection of routes of march with a view to avoiding areas especially favorable for gas attack by the enemy.

(c) In preparation for a movement, insuring that gas protective supplies likely to be needed enroute are packed and transported so as to be readily available.

(d) Checking upon measures for protection of equipment, food, and water against gas.

(e) Advising on means of dealing with gassed areas encountered enroute.

(3) *Duties in battle position.*—(a) Insuring that provisions of general duties outlined in (1) above are carried out.

(b) Indicating to unit commander, areas, if any, which are especially favorable for gas attack by the enemy.

(c) Suggesting measures for protection by disposition of troops, especially in regard to reserves.

(d) Initiating measures for obtaining information of enemy's chemical warfare preparations and activities, that is, reconnaissance, raids, airplane observation, photographs, etc.

(e) Advising on plans of protection in case of gas attack, particularly with reference to selection of alternate positions to be used in case of attack with persistent agents.

(f) Posting regularly a gas situation map showing the location of gassed areas, date of contamination of such areas, and other pertinent data.

(g) Reconnoitering and recommending routes of approach for use in case of an advance.

(h) Insuring that lower units operating in the unit area are known and that their gas protective measures are adequate.

(i) Rendering a report each week on activities as gas officer during the week, stating briefly duties performed and time required.

■ 48. GAS OFFICERS, AIR FORCE UNITS.—In each squadron of the air force an officer is assigned the duties of unit gas officer. His duties and qualifications conform, generally, to those of corresponding size in ground force units.

■ 49. POST CHEMICAL OFFICER.—a. The post chemical officer usually is an officer of the Chemical Warfare Service. He is responsible to the post or air base commander. An officer of one of the arms, of grade commensurate with the duties involved, will, at those posts where an officer of the Chemical Warfare Service is not on duty, be detailed as post chemical officer on the staff of the commanding officer. This officer will supervise the training in chemical warfare of all non-tactical units at his post and perform the duties prescribed by AR 35-6520 so far as chemical warfare supplies and ammunition are concerned. Tactical units, such as divisions, will have their own chemical officer. In this case the post chemical officer performs only his supply function in regard to this tactical unit.

b. On regimental and battalion posts the post chemical officer may be the regimental or battalion gas officer. On

larger posts some other officer normally is detailed. The post chemical officer, as an assistant to the training officer, in turn coordinates the training schedules of the units in chemical warfare. He provides for the issue of gas masks and makes recommendations for the use of the allowances of chemical warfare training munitions.

c. He is responsible for initiating all requisitions through proper channels for chemical warfare supplies which are needed by organizations on the post. He will anticipate such needs and requisition supplies in ample time.

d. He is responsible for all chemical warfare property on the post until it is properly transferred to organizations.

e. He is the commanding officer of all chemical warfare personnel stationed on the post assigned to him for the purpose of assisting him in matters of administration and supply.

f. He renders monthly reports to the service command chemical officer concerning his activities.

g. He is primarily responsible for chemical warfare supply, but he should actively assist in the training of tactical units.

SECTION II

DUTIES OF GAS NONCOMMISSIONED OFFICERS

■ 50. COMPANY.—Two company gas noncommissioned officers are appointed by the company commander.* They assist the company commander in all matters pertaining to defense against chemical attack. Under direction of the company commander they have three specific functions: chemical intelligence, instruction and inspection, and supply and repair.

a. *Chemical intelligence.*—(1) Identification of enemy chemical agents.

(2) Detection and posting of gassed areas.

(3) Assistance to the battalion gas officer in obtaining specific chemical information.

(4) Warning the company commander when weather and terrain features are favorable for enemy gas attacks.

b. *Instruction and inspection.*—(1) Inspection and instruction of gas sentinels in their duties.

* This holds true for similar organizations in other arms and services.

- (2) Inspection of the alarm system.
- (3) Inspection of gasproof shelters.
- (4) Checking upon measures for protecting food and water.
- (5) Checking upon the fit and condition of gas masks.
- (6) Supervision of the decontamination of small important localities.

(7) Acting as assistant instructors in gas mask drill, in the identification of agents, and in other basic subjects.

c. Supply and repair.—(1) Assisting in matters of supply of protective equipment.

(2) Maintaining equipment in good working order.

(3) Assisting regiment gas noncommissioned officers in major repairs of gas masks.

■ 51. BATTALION.—The battalion gas noncommissioned officer assists the battalion gas officer in his various duties. Specifically he is charged with—

a. Checking frequently upon the proficiency of gas discipline and the training of men in each company of his battalion.

b. Inspecting gas masks and other protective equipment and suggesting such repairs as can be made in companies.

c. Working in conjunction with the regimental gas noncommissioned officer in making repairs to protective equipment which cannot be made in the company.

d. Usually accompanying the battalion gas officer in such reconnaissance as he may make.

e. Insuring that gas sentinels are provided and are proficient in their duties.

f. Checking upon the operation of company gas alarms.

g. Keeping the records pertaining to the issue and repair of chemical warfare equipment.

■ 52. REGIMENTAL.—The regimental gas noncommissioned officer works under the direct supervision of the regimental gas officer. In general, his duties consist of the following:

a. Issuance and maintenance of a record of all regimental protective equipment.

b. Assistance to the regimental gas officer in evaluating information and matériel relative to chemical intelligence; in reconnaissance; in establishing data on regimental gas

discipline based upon established standards of proficiency; and the state of protective equipment.

c. Work in close cooperation with the battalion gas non-commissioned officers of his regiment and, through the battalion gas officer, advising and assisting them in the performance of their duties.

d. Under the supervision of the regimental gas officer and assisted by the battalion gas noncommissioned officers, making necessary repairs to protective equipment which cannot be made within the company.

SECTION III

SPECIAL TROOPS AND DETACHMENTS

■ 53. **ARMY SERVICE UNITS.**—*a. General.*—In addition to the chemical weapons units in GHQ reserve, there are five service units that may be part of each army (see FM 3-15). These organizations are—

- Chemical depot company
- Chemical maintenance company
- Chemical laboratory company
- Chemical decontamination company
- Chemical impregnating company

b. Special units.—(1) *Chemical service units with the Army Air Forces.*—Special Chemical Warfare Service organizations are provided for the necessary supply of chemical munitions to combat units of the Army Air Forces.

(2) *Stationary smoke generator company.*—This unit is organized for the express purpose of producing large rear area smoke blankets for the protection of vital defense or industrial installations. Smoke is produced by means of special oil-burning generators serviced and maintained by the personnel of this company. Meteorological and signal detachments are a functional part of the organization, which is motorized.

■ 54. **CHEMICAL DEPOT COMPANY.**—*a. General.*—The chemical depot company maintains the army chemical warfare depot. It is the supply source of protective equipment for the entire army, and the point of supply of offensive equipment and munitions for chemical troops and special air

base service units. The company consists of a headquarters and three platoons. In addition to company administration, mess, and supply, company headquarters handles depot administration. The company is also trained and equipped to perform any field filling of chemical munitions that may be required in the army area. Each platoon is organized to receive, handle, store, and issue all chemical warfare supplies passing through the depot, and accordingly may be detached to operate a chemical depot for a smaller force, such as a corps.

b. Motor transportation.—The unit is not completely motorized, being normally assigned only the transportation required for the interior administration and supply of the company. The transportation required in the reception and issue of depot supplies and in the movement of the unit and the depot is obtained from the army quartermaster.

c. Location.—The army chemical officer makes a reconnaissance and recommends to the army G-4 a site on which to establish the army chemical warfare depot.

■ 55. CHEMICAL MAINTENANCE COMPANY.—*a. General.*—This company is an organization of specially trained personnel with the necessary facilities for repairing all chemical protective equipment of an army and the servicing of chemical weapons used by chemical troops. It consists of a headquarters, a repair platoon, and a salvage platoon. The company is motorized.

b. Salvage service.—(1) The collection of salvage matériel on the battlefield and its delivery to salvage dumps are functions of combat units themselves. Items of chemical warfare equipment thus recovered are delivered by the quartermaster to the chemical maintenance company for repair and return to the depot stock or such other disposition as may be indicated.

(2) Should it be necessary to carry on salvage operations in areas recently subject to attack by such agents as mustard gas, it may be necessary to decontaminate the matériel on the spot before it can be moved and handled with safety. Such salvage work may necessitate the detail of special chemical decontamination troops.

c. Location.—For operations, the chemical maintenance company should be centrally located in the army service area, and near the chemical warfare depot. Personnel of the maintenance company may be required to assist depot troops in case of an emergency.

d. Assignment.—One chemical maintenance company is assigned to each army. The company operates under the control of the army chemical officer. In case the field forces are very large, and extensive chemical operations are being conducted, it may become necessary to provide one or more additional chemical maintenance companies for the communications zone.

■ 56. CHEMICAL LABORATORY COMPANY.—*a. General.*—This organization conducts chemical and physical tests and a limited amount of research work in the field. It is organized into a headquarters section, chemical section, and physical section, and is provided with complete laboratory and testing equipment. The laboratory insures the early investigation and analysis of such chemical agents and weapons as may be employed by the enemy and is prepared to meet technical problems in connection with chemical agents which may arise in the field. Transportation is required to move its personnel and equipment. Personnel are provided with small arms for personal protection but have no combat functions.

b. Location.—The chemical laboratory company is normally centrally located within the theater or army area it serves, with due regard to the road net, since in most instances, the samples of enemy chemical agents, ammunition, and weapons must be brought to the chemical laboratory company for examination and analysis. A city or village is the normal location for this company so that existing buildings and utilities such as electricity, water, and heat may be used.

c. Reports.—Special reports are rendered at any time the laboratory discovers a new enemy chemical agent or munition. Special reports on surveillance of our own chemical munitions are rendered as ordered.

d. Training.—The officers and certain enlisted personnel of the chemical laboratory company are selected on the basis of their training and experience in civil occupations along

lines corresponding to their military duties in the laboratory unit. Thus, the technical training of the unit in the military service is largely an adaptation of their previous training to chemical warfare problems.

e. Assignment.—One chemical laboratory company is assigned to each theater of operations. It operates under the supervision of the theater chemical officer.

■ 57. CHEMICAL DECONTAMINATION COMPANY.—*a. General.*—This company is organized and equipped for decontamination work on a large scale. Various units of the army may call on the company to decontaminate tactically important areas or necessary matériel when the unit is not equipped to carry out the work alone. The organization consists of a headquarters and three decontamination platoons, each platoon consisting of a platoon headquarters and six decontamination squads. The squad is the basic work unit.

b. Location.—The company should be at a central point in the army service area. From this point decontamination details may readily go to affected areas. At all times a sufficient number of decontamination troops should be available to deal promptly with special situations in the army service area. The headquarters of the company should be in the vicinity of the army chemical depot.

c. Use.—The necessity to keep supply installations functioning and the limited number of decontamination personnel generally will preclude their employment in forward areas during combat.

■ 58. CHEMICAL IMPREGNATING COMPANY.—*a. General.*—Chemical impregnating companies are composed of a headquarters section and three platoons for the operation of the plant on a three shift, 24-hour basis. Each platoon consists of two sections, one operating the decontamination equipment and the other the impregnating equipment.

b. Assignment.—Chemical impregnating companies are assigned to an army on the basis of one company to each 40,000 troops, or a small task force. They operate under the supervision of the army chemical officer.

■ 59. MEDICAL GAS TREATMENT BATTALION.—To treat gas casualties expeditiously in the field, a special medical gas treat-

ment battalion is available. This battalion is composed of a headquarters and three clearing companies. Each clearing company has a capacity of 500 patients. Bath and treatment sections are provided in each of the two clearing platoons. Personnel of this battalion are army troops and are especially trained to treat gas casualties.

CHAPTER 4

TACTICAL PROTECTION

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SECTION I

CHEMICAL RECONNAISSANCE

■ 60. **DISTANT.**—Distant chemical reconnaissance is conducted by observers in airplanes and by highly mobile ground forces such as horse or mechanized cavalry.

a. Airplanes.—Distant reconnaissance by airplane provides accurate information of the terrain. Aerial photographs, both vertical and oblique, show the location of wooded depressions, stream beds lined with underbrush, deep defiles, ravines, etc., which, if contaminated by chemicals, would be serious obstacles to advancing troops. This reconnaissance may provide specific information, such as enemy activities indicating installation of chemical mines, cylinders, projectors, etc.

b. Mobile ground forces.—Distant reconnaissance by mobile ground forces should determine the enemy's immediate preparedness for chemical operations, both offensive and defensive. It will be carried out by observation, raids, questioning of prisoners and inhabitants, and by all other available means.

■ 61. **CLOSE.**—Chemical reconnaissance becomes more detailed as opposing forces draw closer together, particular attention then being paid to the terrain with a view to selecting halting points, camp sites, routes of approach, and battle positions which are less favorable to enemy gas attacks. Airplane observation and photographs, and ground reconnaissance by cavalry are of value in developing specific chemical information. Each unit of the main body, however, must reconnoiter on its own front and flanks with a view to selecting routes of approach and alternate routes to be used in case gassed areas are encountered.

a. Reconnoitering gassed areas.—The following information of gassed areas is secured by reconnaissance: location and extent of the area; kind of gas, and whether heavy, medium, or low concentration; availability of routes for troops and vehicles wishing to avoid the area by passing it up wind; availability of routes for passage down wind and the advisability of masking; and the feasibility of preparing a roadway or using some established road or path through the area.

(1) Low-lying patches of woods, defiles, ravines, and stream beds covered with high grass or underbrush are types of areas favorable for gassing with vesicant agents. All such areas should be carefully reconnoitered in situations where there is any likelihood that the enemy is using persistent gas.

(2) Persistent gas having been detected and its character determined, the reconnoitering party, with gas masks adjusted, determines the extent of the gassed area. Some members of the party proceed up wind to determine the edge of the area and the possibility of passage of the area on that side. From time to time they halt and test for gas. They do this as sparingly as possible. In the case of mustard gas, testing every minute or two for 20 or 30 minutes will probably cause severe eye irritation, even though each exposure is exceedingly brief. The ability to detect mustard gas by its odor is also lessened by continued or repeated exposure.

(3) Meanwhile other members of the reconnaissance detail make a similar inspection on the down wind side.

(4) After the extent of the area has been determined, it is marked with gas danger signs showing the kind of gas and the date of contamination or discovery. Other units approaching from the rear should be notified and, if necessary, a sentinel posted at the entrance to the area to give warning. Whether it will be necessary to pass through the area during the reconnaissance depends upon its size and whether routes for passing it to one side or the other are available.

b. Importance of daytime reconnaissance.—It is extremely difficult for reconnaissance to be made of gassed areas at night. When practicable, close inspection of the terrain must be made in the daytime in advance of the march, thus avoiding the possible surprise encounters of such areas.

However, if a gassed area is encountered unexpectedly by an advancing unit, it is essential that reconnaissance be made quickly to determine the best means of passage.

■ 62. BATTLE.—Gas reconnaissance in battle will include gathering and disseminating information on the enemy's actual and potential gas activities. After a gas attack it will include the location of gas free areas for use by troops and information on which to base recommendations for the evacuation of areas rendered untenable by persistent agents.

SECTION II

CHEMICAL INTELLIGENCE

■ 63. GENERAL SOURCES OF COMBAT INTELLIGENCE.—Chemical intelligence in general is derived by the same means and as a part of general combat intelligence, that is, reconnaissance and observation. It deals directly with information of chemical activities, intentions, equipment, munitions, and training of the enemy forces in the field, and is handled through the regular intelligence agencies in the same manner as any other information of the enemy.

■ 64. SPECIAL SOURCES OF INFORMATION.—Information from any reliable source obtained by unit commanders is the basis for planning chemical security for the unit and, with such interpretative comment as they may make, is turned over to the intelligence officer of the unit to be included in his reports to higher headquarters. Local information of enemy developments is obtained from interrogation of prisoners and from the examination of captured installations, matériel, and munitions. Samples of chemical agents, gassed earth, chemical shell, fuzes, and similar items, as well as masks and protective equipment, are secured from all possible sources. Thus chemical combat intelligence is coordinated and becomes of general information for the entire army.

■ 65. INFORMATION CHANNELS.—When gas noncommissioned officers obtain information relative to the use of chemical agents, they immediately transmit their findings to their unit gas officer (battalion or regimental). He delivers the

information to two distinct agencies, the unit intelligence officer and the division chemical officer. Each of these officers makes a tentative evaluation of the data and forwards it to higher authority.

■ 66. CHEMICAL WARFARE INTELLIGENCE FACTORS.—The following factors of chemical combat intelligence are the most important to be considered:

a. Observation and consideration of local weather conditions, and whether favorable or unfavorable for enemy gas attacks of any kind.

b. Probable intention of the enemy with respect to employment of chemical agents as indicated by his armament and activities.

c. Location and disposition of the enemy, particularly chemical troops.

d. Location of terrain features which are likely to be traversed or occupied by our own troops and which are good target areas for gas.

e. Location of enemy emplacements or installations for projection of gas.

f. Character and amount of enemy chemical weapons and ammunition with special regard to any new developments.

g. State of enemy gas discipline, training, and protective equipment.

h. With respect to any particular gas attack, the amount and kind of chemical agent used; method of attack; number of projectiles fired; caliber, marking, and distinctive features of gas projectiles; location of areas affected; date, if contaminated with a persistent agent; casualties resulting; and any other pertinent data.

i. Location and extent of all contaminated areas.

j. Interpretation of the enemy's chemical tactics, that is, what they may indicate as to his subsequent intentions.

k. Information relative to our own use of gas, state of protective equipment of our own troops including gasproof shelters, and available protection of equipment, food, water, and general supplies.

■ 67. INTELLIGENCE REPORTS.—a. *G-2 reports*.—Intelligence summaries and bulletins issued by higher headquarters con-

taining information on general chemical warfare developments and the results of late research and experimentation are furnished the division chemical officer for distribution to all concerned.

b. Records.—(1) *Statistical records.*—Preparation of statistical records of both the enemy and our own gas attacks is an important duty of the division chemical officer. Data required include the weather conditions, time, place, and duration of attack, munitions employed, area and number of troops affected, protective measures taken, and the number, types, and seriousness of casualties. This information is secured piecemeal and incomplete from such sources as G-2, the artillery, chemical troops, Medical Department, and unit gas officers. It is assembled and transmitted to higher headquarters for study and record.

(2) *Reference records.*—Each item of information should be recorded in such a manner that it will be convenient for reference and study. It may be recorded in one or more ways: in the G-2 journal, the G-2 work sheet, or upon the G-2 situation map.

c. Special reports.—Matters of extreme urgency are transmitted by the best means available from either the higher authority to lower or vice versa. Frequent conferences are also a means of receiving special information vital to the operation.

d. Evaluation of reports.—All information, no matter how trivial, should be sent from the front to higher authorities and forwarded to corps or army G-2 centers. What at first may appear of no consequence, may, in the final analysis, prove to be the missing fragment in the unfinished picture when evaluated by the proper authorities.

■ 68. COUNTERINTELLIGENCE.—The object of counterintelligence is to destroy the effectiveness of the enemy intelligence system. As this applies to gas officers and gas noncommissioned officers, several means are available as follows:

a. Secrecy.

b. Gas discipline.

c. Concealment.

d. Tactical missions designed to deceive the enemy.

e. Precautions in the movement of troops, individuals, and matériel.

f. Censorship.

g. Counterespionage.

h. Restrictions on the preparation, transmission, and use of documents.

SECTION III

PREPARATIONS TO MEET A GAS ATTACK

■ 69. ESTIMATE OF THE SITUATION.—Unit gas officers must be constantly on the alert for signs of an enemy gas attack and be familiar with conditions which favor the use of each class of chemical agents.

a. An enemy may use nonpersistent gas—

(1) Between midnight and sunrise, when ground temperature is lower than air temperature and troops are least alert.

(2) When wind velocities are not over 12 miles per hour.

(3) When wind direction is either from the enemy or parallel to the front.

(4) When troops are in large concentrations, located in low ground or in woods.

(5) On overcast days.

NOTE.—An enemy may use nonpersistent gas at any time and under any conditions. He will try to gain surprise by using it under most unfavorable conditions.

b. An enemy may use persistent gas—

(1) Against defense areas which would be very difficult for him to capture by assault and which he does not expect to occupy or pass through.

(2) In defiles.

(3) On terrain surrounding approaches to fords, bridges, and on beaches.

(4) On artillery firing positions.

(5) On distributing points, airdomes, bivouac areas, railheads, marching troops, and supply columns, especially by spray from attack aviation.

(6) On his withdrawal. He may be expected to leave bands of vesicants in front of or within his former position and on routes that are likely to be used by pursuing forces.

(7) On important routes of approach.

c. An enemy may use incendiaries—

(1) Against villages largely of frame construction.

(2) Against army depots, airdromes, and large supply centers well to the rear where inflammable supplies, such as ammunition and forage, are stored in large quantities.

(3) Against positions located in dry grain fields or woods.

■ 70. GENERAL PLANS.—*a.* Each division in the theater of operations will follow the plan for protection against chemical attack previously prepared (standing operating procedure).

b. Component units of a division will enforce the standing operating procedure and prepare such other plans as are necessary for the protection of personnel. These plans will apply to the local situation and are incorporated in field orders.

c. All such plans should be carefully coordinated in the general scheme of attack or defense.

d. Normally the occupation of an alternate position is carried out only on orders from the next higher headquarters. In no case should withdrawal from an original position be undertaken until it is clear that the enemy is using a highly persistent gas in sufficient quantity to render the area untenable.

■ 71. STANDING OPERATING PROCEDURE.—*a. Definition.*—Standing operating procedures for defense against chemical attack are general orders issued by each army, corps, division, or smaller force, if acting independently, which set forth definite and uniform procedure in the protection of the command against gas. Adopting such procedures will save time in the preparation and issuance of orders, minimize the chances for confusion and errors when under stress of combat, and greatly simplify the execution of operations in the field. Organizations thus trained become habituated in the procedures involved. As a result the methods prescribed for the performance of certain operations become routine.

b. Preparation.—Standing operating procedure is prepared for the unit when organized and represents the best practices known for protection at the time. As means of protection become improved, it may become necessary to modify

the standing operating procedure. Similarly, methods may be changed, not only through development to obtain greater efficiency, but also due to local conditions in various theaters of operation, necessitating revision of the standing operating procedure. Accordingly, the chemical officer must be constantly on the alert to obtain greater efficiency in the protection of the personnel in his care.

c. Form.—For a suggested form for standing operating procedure for defense against chemical attack, see appendix III.

■ 72. DISPOSITION TO MEET A GAS ATTACK.—*a. Effect of weather and terrain.*—Conditions which favor an enemy gas attack and which a unit commander must take into consideration are covered in paragraph 69.

b. Selection of favorable localities.—(1) Defiles, ravines, and depressions are very likely to be heavily gassed by the enemy to hamper and delay the advance of opposing forces. Occupation of these areas should be avoided if possible, and in no case should they be entered before a gas reconnaissance has been made. Wooded areas or those covered by heavy underbrush should also be thoroughly reconnoitered before they are entered.

(2) The tactical situation: ~~is~~ the determining factor whether a particular position will be occupied or not. As a rule, the terrain features which afford the most cover from rifle fire and shells are those which contribute most to the effectiveness of gas. The gas problem may sometimes be the lesser of the two, in which case troops should hold their position in a contaminated area.

c. Avoiding contaminated areas.—The effectiveness of non-persistent gases is of short duration inasmuch as they dissipate within 5 to 30 minutes, depending upon the terrain and weather conditions. The enemy's use of vesicant agents, which usually contaminate for several days, offers the most danger to personnel crossing a contaminated area because of liquid splashes on the ground, grass, and underbrush. If possible, such an area should be avoided through proper reconnaissance.

■ 73. PROTECTION AGAINST CHEMICAL ATTACK FROM THE AIR.—*a. General.*—(1) No area can be designated as a safety zone

against chemical attack from the air. Bombardment aviation of all types can be used for chemical attack on targets within its range. It is equipped for releasing chemical bombs and for spraying chemical agents from tanks in the form of a fine rain or mist.

(2) Using proper methods of concealment, the extent of an area which can be gassed in this manner depends upon the number of airplanes engaged.

(3) In the forward areas it is necessary that all chemical protective equipment be ready for instant use at any hour of the day or night. All installations within bombing range should also be supplied with equipment necessary for the protection of personnel and supplies against chemical agents released by bombs or from spray tanks.

b. Movements by rail.—Entraining and detraining points are excellent targets for gas attacks. It is therefore desirable to utilize a number of such points distributed along the railway line in order that a large troop concentration in any one area may be avoided. Concealment and secrecy of such operations must be maintained. Once entrained in covered cars, troops provided with gas masks will be fairly safe against gas attacks.

c. Motor convoys.—Measures aimed at avoiding gas attacks by aircraft upon motor convoys are the same as those applicable to other forms of air attack. Until an air attack is actually launched it is impossible for ground forces to determine whether high-explosive bombs or chemical agents, or a combination of both, are to be employed. Against high explosives it may be advisable that troops leave their trucks and deploy. However, such action will usually increase their vulnerability to chemical spray attack, and the judgment of the commanding officer will govern the action to meet each situation as it arises.

d. Marching columns.—(1) In the case of marching columns of troops, whether mounted or dismounted, the possibility of aircraft gas attack imposes the same complication in the problems of protective procedure as with motor convoys, that is, the impossibility of foretelling the kind of attack, whether with high explosive or chemical agents or both, and the fact that protective formations against bombing attack may be of little or no value against chemicals.

(2) In order to meet this dual situation, troops marching in column must have their chemical protective equipment ready for immediate use at all times. Advance, rear, and flank guards, posted and moving with the column at strategic points along the route of march, insure comparatively quick alarm of approaching airplanes. Troops can adjust their chemical protective equipment as they deploy, assuming any new formation in time to meet an air attack either by high explosive or chemical agents.

e. General security provisions.—Attack by enemy airplanes equipped for chemical operations can be made upon a marching column at any point along its route, but is more likely at places where nearby woods or hills afford some concealment for airplanes in their approach. Defiles and valleys where wind velocity is likely to be retarded are more likely to be selected for attack than are open, wind-swept areas. Security provisions in general against air attack upon moving columns are briefly outlined as follows:

(1) *Warning of attack.*—Distant warning from mobile radio observation units and immediate warning from observation patrols are sent out from the column.

(2) *Concealment.*—To facilitate concealment, night movements are the general rule. Since air attacks normally are planned in advance with the view of striking a moving force at some certain point on its probable route, the use of road nets should be varied in order to deceive the enemy.

(3) *Protective formation.*—Intervals should be increased between units when approaching defiles in order to render observation by aircraft more difficult.

(4) *Movement.*—As soon as possible after a chemical attack by airplanes upon a column, troops are moved up wind out of the gassed area since, aside from contamination of ground and vegetation, the vapor concentration from such an attack is likely to be high. The up wind edge of the gassed areas will probably be nearby in most cases. Immediate inspection is made to determine the results of the attack, and such first aid and decontamination measures as practicable are taken forthwith.

f. Use of woods for protection.—Wooded areas should be avoided as a general rule in safeguarding against gas, but

there are some exceptions. For marching columns, secrecy of movement can be secured occasionally by traversing woods. Where there is a line of woods in full leaf parallel to a road and an air attack is expected, it is advantageous for the column to move off the road along the edge of the woods. If attacked by airplanes using chemicals, troops seek cover in the woods, leaving the cover as soon as the airplanes have passed. The thick foliage overhead in such a case will afford considerable protection against liquid chemical spray.

■ 74. PROTECTION DURING MOVEMENTS INTO COMBAT.—*a. Camps and bivouacs.*—High ground is sought for gas protection. Heavily wooded patches, especially ravines, are avoided. Water sources at camp sites are carefully examined for gas contamination before use. Gas sentinels are posted over sleeping men. Where troops are halted for the night in positions likely to be attacked with persistent agents, alternate positions for each unit to occupy in case of necessity are selected.

b. Selection of routes of approach.—(1) Routes of approach along high ground are preferred. Wooded defiles and ravines are regarded with suspicion, avoided if possible and, in any case, reconnoitered for gas before a march is made into them.

(2) In addition to the route selected for a movement, one or more alternate routes for use in case the route first selected is gassed should be reconnoitered in advance. Selection of alternate routes is particularly applicable in the case of units advancing to assembly positions. While the zone of advance may be clear of gas when it is reconnoitered, it may be gassed later on. The enemy will seek to lay down gas at a time calculated to obtain maximum effect and when it is too late for the advancing force to make new plans.

(3) In situations where it is likely that persistent gas will be encountered, advance guards or other covering forces will invariably include a gas reconnaissance party and personnel equipped for decontaminating operations. Such troops, provided with protective clothing, necessary tools, and decontaminating chemicals, will be able to deal with minor gas situations encountered on the march, such as contaminated bridges, road junctions, and obstacles on the road, thus obviating serious delays of the main body. Decontamination

troops of each combat battalion should be provided with a truck, carrying tools, protective clothing, and decontaminating materials. The squad, wearing protective clothing, should be ready to move forward promptly when such situations are encountered.

(4) Upon encountering an area contaminated with persistent gas, its location will be reported immediately to higher authority and marked with signs indicating the gas danger and giving the date on which the gas was discovered. This enables other troops approaching the area, at some later date to determine whether it is still likely to be dangerous.

c. Avoiding contaminated areas.—(1) Areas contaminated by a vesicant should be avoided and passed up wind. In ascertaining the down wind distance at which an area contaminated with a vesicant may be passed with reasonable safety, several factors must be considered: the depth and width of the area, the gas concentration, temperature, wind velocity, and the time required to pass the area in the particular situation. Where exposure will be for 10 minutes or less it is possible that masked troops might pass close to the area without casualties resulting, even though the concentration be very high.

(2) If troops are held up by enemy fire on the down wind side of a mustardized area, numerous casualties might result even though the area itself was small and the gas concentration low. Assuming no delay, it is probable that in most cases it will be reasonably safe to pass such an area on the down wind side at a distance equal to its depth. If the odor of gas is detected, gas masks will be worn.

d. Passing through contaminated areas.—Where entirely impracticable to pass around an area gassed with vesicant agents and when troops must still continue forward, consideration should be given to all possible means of minimizing danger of casualties in passing through the area. Factors to be considered are the depth of the area, gas concentration, probable length of time troops will be exposed, presence of thick vegetation, and terrain with respect to its being bare or grass-covered, wet or muddy, dry or dusty.

(1) Where there is a hard-paved road through the area, it is probable that troops may pass on the road without great

danger provided they wear masks and that they do not remain exposed for any appreciable length of time.

(2) Where the road through the area is unpaved and muddy, care should be taken to avoid splashing. Upon leaving the area the muddy feet of men and animals should be cleaned with water, brush, grass, etc. Bands of bleaching powder (chlorinated lime) placed at the exit from such areas will assist greatly in neutralizing any agent picked up on shoes.

(3) Where the road or area to be crossed is dry and dusty, an effort should be made to prevent a thick cloud of contaminated dust from rising.

(4) Wooded patches, ravines, hollows, and defiles, and especially lateral stream beds across the zone of advance, may be prepared for passage by sending forward details to cut lanes so that the bulk of the force may pass through without brushing against vegetation. Reconnaissance may result in the location of openings through the area so that little cutting will be required. Those detailed to cutting lanes will be provided with protective clothing.

(5) Long grass and brush contaminated with mustard gas or similar agents may sometimes be burned to render the area safe for passage. During such burning troops will be kept up wind.

e. Occupation of a position.—In occupying a new position, or in the relief of units at the front, unit areas should be reconnoitered in advance of the arrival of troops. In case the area is to be prepared for defense, plans for chemical protection should be coordinated with field fortification plans.

■ 75. PROTECTION DURING COMBAT.—Where nonpersistent gas is used, troops must prepare to repel an assault. Other than this, all unnecessary movement should cease until the gas has disappeared. Nonpersistent gas is generally employed in situations where the enemy has time and facilities to bring forward the necessary munitions. Since surprise is of great importance, such attacks are likely to be made at night or early in the morning when troops are asleep. After any gas attack troops should be prepared for a second attack.

■ 76. IMPORTANCE OF OFFENSIVE ACTION.—Artillery can be used to advantage to forestall gas attacks or prevent the enemy

from exploiting them. Whenever installations or preparations for the projection of gas are located, they are promptly bombarded with a view to their destruction.

■ 77. OCCUPATION OF CONTAMINATED AREAS.—*a.* The length of time men wearing ordinary clothing can remain in an area contaminated with a vesicant before becoming casualties will probably not be more than a few hours. Such troops are unlikely to be of much value after this time.

3. When imperative to utilize the position, as few men as are absolutely essential should be left in the area. They should be provided with all possible means of protection and relieved after 2 hours or sooner, if practicable. It will sometimes be feasible to withdraw initially all men from the area, sending a small number back into it only when fire from this position is required.

■ 78. PLANS AND ARRANGEMENTS FOR DECONTAMINATION.—To be prepared for the decontamination of areas or matériel, it is essential that plans be devised for such a contingency. These will provide for trained personnel, protective clothing, tools, transportation, decontaminating apparatus, and materials. When the plans are completed, steps should be taken to insure that all features are available and in readiness. If the action indicates a probable attack with vesicants, materials should be moved as close as practicable before the attack so that decontamination can be accomplished in a minimum of time.

■ 79. PROTECTION DURING PURSUIT.—In pursuit of a retreating force it is essential that there be no relaxation in gas protective vigilance. The enemy is likely to make extensive use of gas, particularly of the vesicant type, in rear guard action. Pursuing forces then must be on constant guard against blundering into contaminated areas. Localities likely to be gassed to hamper pursuit should be carefully reconnoitered before troops enter them.

■ 80. PROTECTION IN COOPERATION WITH FRIENDLY CHEMICAL ACTION.—*a.* When using nonpersistent agents.—When nonpersistent agents are used by friendly troops it is essential that our troops be on the alert for a change in wind direction. This change may cause the agent to be carried back

to our lines. In firing Livens projectors the prescribed safety limits must be observed.

b. When using persistent agents.—Areas on which persistent agents are fired should be known to all unit commanders who may in any manner be affected by their use. If units, according to plan, are likely to pass through or near such areas, the location must be known in order that personnel may avoid them.

c. Artillery use of chemicals.—All use of chemicals by the artillery should be previously noted by the proper unit commanders in order that patrols and scouting parties may be on the alert. Targets for friendly artillery bombardment should be known and, when necessary, troops removed a safe distance to minimize casualties.

■ 81. MEASURES TAKEN AFTER A CHEMICAL ATTACK.—As soon as possible after a gas attack, first aid should be given to gas casualties and provision made for their evacuation. If gas-proof shelters have been provided, they should be ventilated and prepared for another gas attack. Contaminated food and water should be disposed of; contaminated weapons and equipment should be decontaminated and all metal parts oiled; and contaminated areas that must be occupied should be decontaminated. After the attack it may be found that additional protective equipment is required or that some of the equipment on hand should be replaced. This should be promptly requisitioned and supplied to the using units and individuals.

■ 82. DECONTAMINATION OPERATIONS AFTER A CHEMICAL ATTACK.—Plans having been made, decontamination of areas or matériel should proceed without delay so that operations may not be unduly impeded. If it is imperative to decontaminate an area, a minimum of space should be treated. It is much better to have a small path through an area than to take the time, effort, and material to decontaminate the entire area.

■ 83. REPORTS.—*a. Immediate.*—As soon as a gas attack takes place, the unit gas officer will determine the time, place, extent of the attack and, if known, the type of weapon used. This information is immediately transmitted either in person

or by telephone to the unit S-2, and also to the division gas officer. A formal report is likewise immediately prepared and sent by messenger to the same agencies.

b. Later reports.—A second report will be rendered, giving the extent of casualties, the duration of the attack, and the boundaries of areas made unfit for occupation because of the presence of a highly persistent agent. These later reports will be sent both to the unit commander through his S-2 and to the division chemical officer.

CHAPTER 5

USE AND CARE OF INDIVIDUAL PROTECTIVE EQUIPMENT

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SECTION I

GENERAL

■ 84. ADJUSTMENT PROCEDURES.—*a.* In the gas mask drill, with any type of mask, the important thing is to be able to put on the mask and secure a protecting fit with the least excitement and with reasonable speed. Personnel carrying and wearing masks should be so familiar with the mechanics of donning a gas mask that, in an emergency, the movements necessary will be automatic, subconscious actions rather than separate and set motions. This requires repeated drill. Preliminary drills will be by numbers in order to acquire completeness and accuracy in adjustment and to habituate the individual in its correct manipulation. Proficiency in this drill will be followed by training without the numbers to insure rapidity of adjustment. These drills are procedures designed to emphasize smooth, rapid, and accurate handling of the gas mask. Although precision is to be desired, gas mask exercises should not be given as disciplinary drills. As a rule, careful adjustment is more essential than great speed.

b. Training in holding the breath also will be included. Holding the breath applies only to drill without the numbers. Its importance should be emphasized and men should be taught to hold their breath immediately upon detecting gas

or upon hearing the gas alarm or the command GAS. Emphasis should be placed upon not taking in additional air before starting to hold the breath (fig. 18). Sufficient air is always in the lungs to enable anyone to clear his mask even if he had previously exhaled. Practically all individuals can hold their breath for 20 or 30 seconds which allows ample time to adjust the mask.



FIGURE 18.—Holding breath.

■ 85. INSPECTION PROCEDURES.—Each individual is responsible for the condition of his protective equipment. Any fault which renders the equipment inoperative should be corrected. Inspections will be made not only for faulty equipment but also as a check on the training efficiency and gas discipline of

personnel. Before going into combat, visual and service inspections should be made not only at stated intervals but also at the discretion of the unit commander.

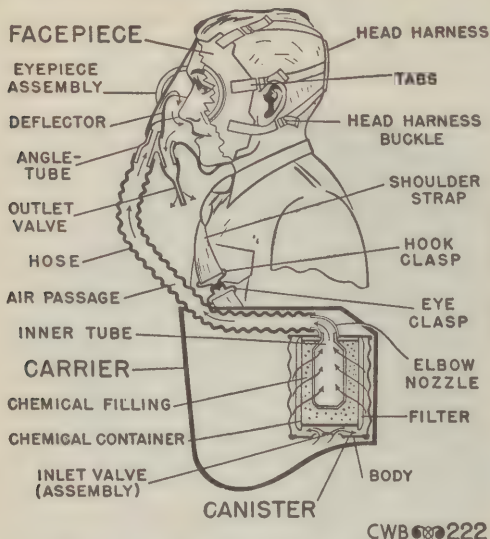


FIGURE 19.—Service mask—cross section.

SECTION II

SERVICE AND DIAPHRAGM GAS MASKS

■ 86. GAS MASK DRILL.—Preliminary drills will be by the numbers in order to acquire completeness and accuracy in adjustment of the mask and to habituate the individual in its correct manipulation. Proficiency in this drill will be followed by training without the numbers to insure rapidity of adjustment. The drill will be executed at ease. Training in holding the breath will also be included, but it applies only to drill without the numbers.

a. *To sling the mask.*—The command is: 1. SLING, 2. MASK. At the command MASK, hold the carrier by the left hand near

shoulder strap eye clasp, waist high, in front of the body with flap and snap fasteners next to the body. Straighten the shoulder strap and hold extended by the right hand, with the palm upward (fig. 20).



FIGURE 20.—Slings mask—first position.

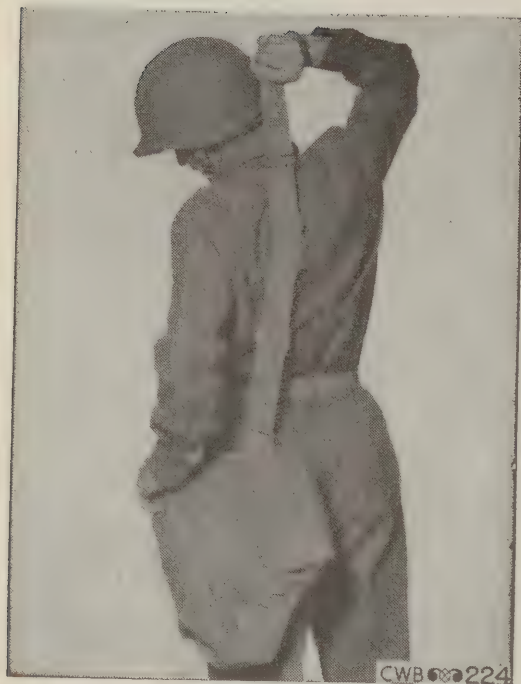


FIGURE 21.—Slinging mask—second position.



FIGURE 22.—Fastening clasp.



FIGURE 23.—Packing strap under carrier.

TWO. Swing the right arm to the left with the shoulder strap passing around left elbow (fig. 21). Bring the shoulder strap over the right shoulder and fasten the clasp (fig. 22). Fasten the body strap. (See notes 1 and 2 below).

NOTES.—1. In adjusting the shoulder strap to the body, the two shoulder sling slides should be so equalized that the stitched-in offset in the center of the shoulder strap will rest on the right shoulder. The distance between the top edge of the carrier and armpit should be about the width of the hand.

2. In adjusting the body strap, the strap can be lengthened or shortened by adjustment of the body strap slide.

3. When using the mask with full field equipment, the procedure is to sling the mask and then sling the pack. Unfasten left front pack suspender strap and pass it under carrier shoulder strap (fig. 23). Resnap suspender shoulder strap to its proper hole and fasten cartridge belt.

4. For medical personnel carrying first-aid equipment, it is necessary to sling the service mask after slinging the first aid pouches.

5. When equipment is removed for any reason except for display, gas masks will be retained on the person. Remove equipment in reverse order.

b. To unsling the mask.—The command is: 1. UNSLING, 2. MASK. Using both hands, unfasten body strap, unfasten shoulder strap and toss back over shoulder. Hold carrier with left hand, waist high (fig. 20).

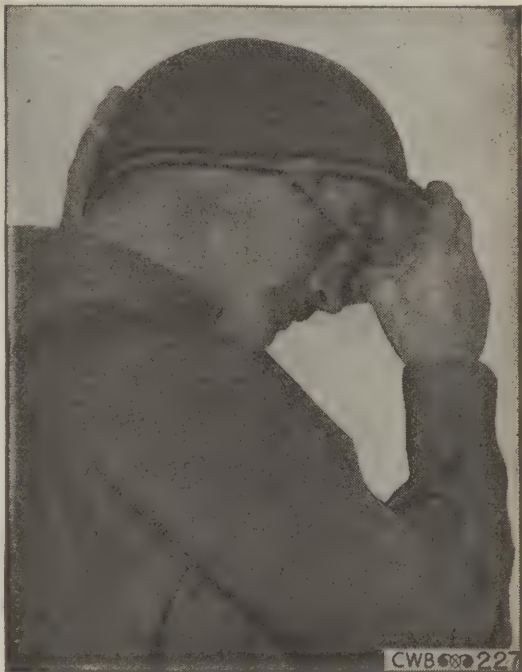


FIGURE 24.—Removing headpiece.



FIGURE 25.—Opening carrier.

■ 87. TO ADJUST THE MASK.—The mask being slung, the command is: GAS. At the command GAS, dispose of arms, etc. Remove and dispose of the head covering with the right hand (fig. 24) (see note 4, p. 119), and open carrier flap with the left hand (fig. 25). Grasp the facepiece with thumb and fingers of the right hand just above the angletube (fig. 26). Bring the facepiece smartly out of the carrier, flipping the head harness out. Grasp facepiece with both hands, sliding

the thumbs up inside and under the lower and middle head harness straps, fingers extended outside of the facepiece almost above the eyepiece. Bring facepiece up in front of the face. Thrust out the chin (fig. 27). (See notes 1, 2, and 3, p. 118.)



FIGURE 26.—Withdrawing facepiece.

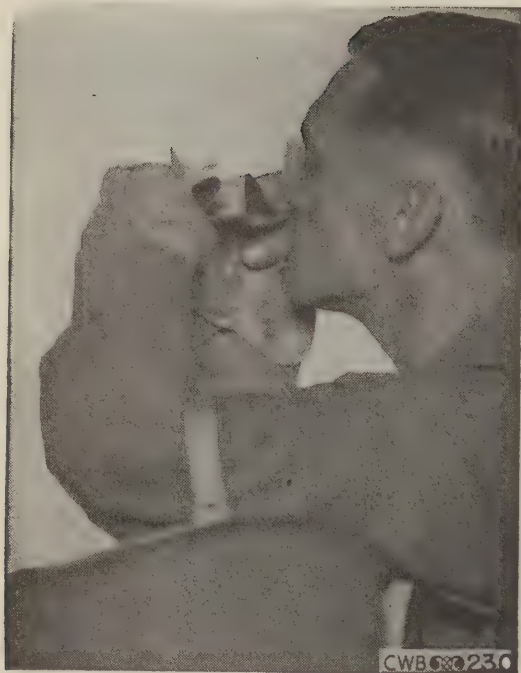


FIGURE 27.—Thrust chin forward.

TWO. Seat chin pocket of facepiece firmly on the chin, holding the head stationary. Sweep head harness smoothly over the head without twisting elastic webbing straps (fig. 28) and center the headpad (fig. 29). Seat the edges of facepiece on the face, beginning with the palms of both hands at the chin, and with an upward and backward motion press out all irregularities and channels (fig. 30).



FIGURE 28.—Carrying head harness over head.



FIGURE 29.—Center pad well down and centered.

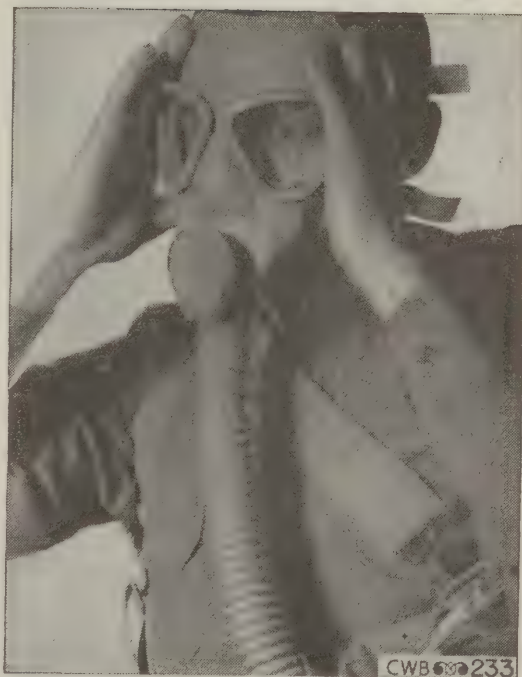


FIGURE 30.—Pressing mask to face.



FIGURE 31.—Clearing mask.

THREE. Close outlet valve between thumb and fingers of the right hand and exhale vigorously to clear the facepiece of gas (fig. 31). If valve is on front of facepiece, place the right palm over the outlet valve. Make sure it is closed (fig. 32), and exhale vigorously to clear the inside of the mask of any gas. (See notes 5 and 6, p. 119.) Check mask by pinching the hose near the canister to shut off the air supply. Inhale. No air should enter and the facepiece should collapse against the face (fig. 33). (See par. 90.)



FIGURE 32.—Clearing mask—continued.

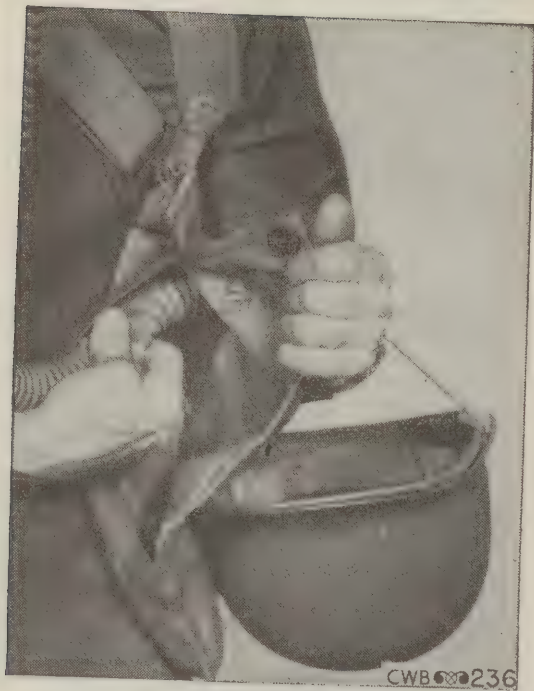


FIGURE 33.—Checking mask.

FOUR. Replace headpiece (fig. 34). Turn the head to the right to draw the full length of the hose from the carrier. While in this position, fasten carrier flap over hose, using the fastener nearest the hose (fig. 35). Snap lower fastener on carrier (fig. 36). Resume original position (fig. 37). (See notes 7, 8, and 9, p. 119.)



FIGURE 34.—Replacing headpiece.



FIGURE 35.—Fastening carrier flap.



FIGURE 36.—Closing bottom of carrier.

NOTES.—1. Without the numbers, at the command GAS, immediately stop breathing. Ability to hold the breath for 30 seconds or more under conditions of excitement should be developed. Do not take another breath, even if the breath has just been exhaled, until the facepiece is adjusted and cleared (fig. 18).

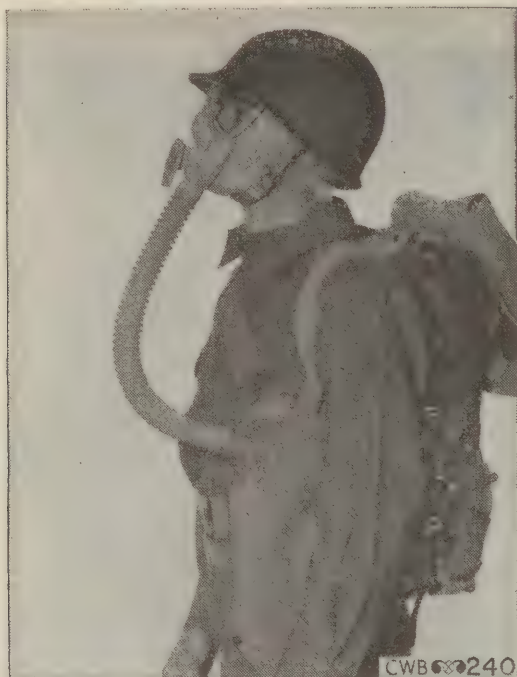


FIGURE 37.—Service mask adjusted.

2. Dismounted troops armed with or carrying weapons and equipment will immediately dispose of equipment and free both hands without permitting any part of the equipment to touch the ground unless absolutely necessary (fig. 38). Mounted troops and animal drivers will halt and temporarily free both hands by disposing of the reins in such a manner as to prevent the mount or team from bolting.

3. After disposing of weapons during adjustment of the gas mask, pass the head or chin strap of head covering over the left forearm. Soft cloth caps and headpieces without head or chin straps will be tucked in the waist or cartridge belt or between the carrier and the body.

4. To remove the M1 helmet, take the chin strap with the fingers of the right hand and pull it up over the chin and nose, grasping the front of the helmet with the hand. Place the left hand at the back of the helmet and with both hands (fig. 24) lift the helmet from the head with a backward sweep. Hang on left arm.

5. To clear the MII diaphragm mask, close the outlet valve using fingers of the right hand to press it flat against the diaphragm guard and exhale.



FIGURE 38.—Do not lay equipment on ground.

6. For adjustment without the numbers, resume normal breathing as soon as the mask is cleared, seated, and checked.

7. Headpieces having chin strap which can be unfastened will be placed under the chin and refastened, otherwise the chin or head strap will be adjusted to the back of the head.

8. Weapons or equipment will be brought to the original position.

9. Mounted troops and drivers will dismount and adjust animal masks (pars. 159 and 160).

10. When the toque and/or hood are worn, the following modifications of gas mask drill are necessary:

a. To adjust mask.—At the command GAS, dispose of arms, etc., and remove headpiece in the following manner: Insert thumb of right hand between chin strap and cheek, slide thumb down and remove chin strap from under chin. Using both hands, lift helmet off head with a backward sweep to prevent neckband binding. Dispose of helmet by hanging it by the chin strap over left arm. If knitted cap is worn, remove it from head and place in helmet. If toque and hood are worn, open front and push hood off head, letting it hang about neck. If toque has front that can be opened around neck, open front and push back over head at the same time



FIGURE 39.—Extending hand through face opening of toque.

hood is removed. If toque does not have front opening, remove and thrust it, neck first, over the right arm, extending the right hand through the face opening (fig. 39). Remove facepiece from carrier in the usual manner and draw it through the face opening of toque and push toque down over hose (fig. 40). Place the facepiece on the head and after clearing the facepiece, put the toque on the head with the outlet valve outside the toque (fig. 41). Replace the hood and helmet by unhooking the helmet strap and refastening it under chin (fig. 42).

b. To test for gas.—If toque and hood do not open, thrust the first two fingers of the right hand under the toque and hood and pull facepiece away from right cheek. Test for gas as described in paragraph 88. If toque and hood can be opened in front, test for gas in the manner described in paragraph 88.

c. To remove mask.—Unhook chin strap of M1 helmet. Using both hands, lift helmet off head with a backward sweep. Refasten chin strap and hang helmet by chin strap over left arm. If knitted cap is worn, remove it from head and place in helmet. If toque



FIGURE 40.—Drawing toque down over hose.

and hood open in front, open and push back off head to hang about neck. If toque does not open in front, remove it and bring down over hose. Remove facepiece and grasp top of facepiece with the right hand and carry toque up over facepiece and on right arm. Replace facepiece in usual fashion. Replace headgear.

■ 88. To TEST FOR GAS.—The facepiece being adjusted, the command is: **TEST FOR GAS.** Take a moderately full breath, exhale part of the air breathed, and stop breathing. Stoop to bring the face as close to the ground as possible without touching any part of the person or equipment to the ground. Insert two fingers of the right hand between face and facepiece near the cheek to permit air to enter at that point. Sniff gently but do not inhale (fig. 43). Resume the erect position. Clear the facepiece as prescribed in the adjustment for the count of **THREE.** Resume normal breathing.



FIGURE 41.—Placing toque over head.



FIGURE 42.—Toque and hood adjusted over mask.



FIGURE 43.—Testing for gas.

NOTES.—1. Personnel will be taught to test for gas habitually before removing the mask.

2. If mounted, dismount.

■ **89. TO REMOVE AND REPLACE MASK.**—The mask being adjusted, the command is: 1. REMOVE AND REPLACE, 2. MASK. First test for gas as prescribed in paragraph 88 (fig. 43). (See notes 1 and 2, p. 130.) If no gas is detected, lift the headpiece with the left hand, and with the right hand grasp the facepiece around the angletube. With a downward, outward, and upward motion remove the facepiece (fig. 44). Place in the crook of the left elbow. Replace headpiece, using

both hands (fig. 45). (See note 3, p. 130.) Regrasp facepiece in the right hand, chest high, with angletube grasped by the fingers and thumbs with edges of facepiece on the top (fig. 46).



FIGURE 44.—Removing mask.



FIGURE 45.—Replacing headpiece.



FIGURE 46.—Holding mask in right hand.



FIGURE 47.—Folding head harness.

TWO. Open flap of carrier with left hand. Pull slack of hose out of carrier. With left hand, fold head harness inside facepiece (fig. 47). With right hand, bring facepiece toward carrier. With left hand, loop hose over outlet valve guard and through facepiece, holding hose in this position with thumb and fingers of the right and just below the eyepieces (fig. 48). (See note 3, p. 130.) Make sure that the hose is not kinked or stretched over outlet valve guard. Hold carrier flap open with left hand. Insert the loop in the carrier (fig. 49).



FIGURE 48.—Holding hose in facepiece.

THREE. Gently insert the facepiece in the carrier, hose at the bottom of carrier, facepiece erect with eyepieces to the front. Refasten carrier and check position of hose and outlet valve guard.

NOTES.—1. If wearing a helmet, prepare the headpiece for removal by unsnapping the chin strap.

2. Arms and equipment will be placed in the most convenient way to free both hands while removing the mask. If possible, avoid grounding arms or equipment.

3. With head coverings equipped with chin straps, remove the headpiece and hold in left hand, then remove mask and hang facepiece over left arm to free both hands while replacing headpiece.

4. Due to the width of the diaphragm mask just below the eye-pieces, it will be necessary to hold the hose in position in the facepiece with the fingers of the right hand held just above the eye-pieces.

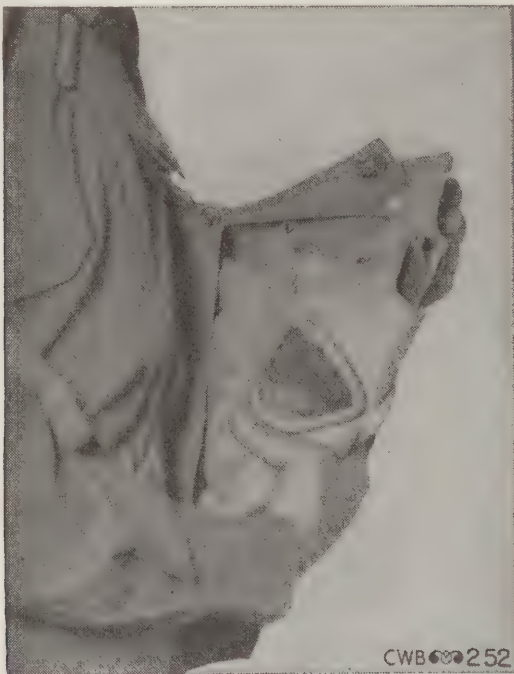


FIGURE 49.—Inserting hose in carrier.

■ 90. To CHECK FIT OF MASK (see notes 1 and 2, p. 131).—The facepiece being adjusted, the command is: 1. CHECK, 2. MASK. At the command MASK, open carrier flap. Pinch together the walls of the hose near the canister. Exhale fully. Inhale.

The facepiece should collapse against the face (fig. 33). (See note 3 below.) The outlet valve should permit free escape of air. (See note 4 below.) If the mask checks, fasten flap carrier and resume normal breathing. (See note 5 below.)

NOTES.—1. Masks should be habitually checked each time after adjustment.

2. **CHECK MASK** is performed as a part of inspection in ranks. (See par. 105.)

3. If the face piece does not collapse against the face at this time and there is leakage of air into the facepiece, two possible faults are indicated:

First.—If the leakage is noticed between the edges of the facepiece and the face, faulty adjustment and fitting are probable. Such a fault may be overcome by pressing the edges of the facepiece to the face, readjusting head harness, by carefully pulling up each of the opposing pairs of head harness straps a little at a time. The ends of the straps in each pair should be exactly the same length, insuring equal tension on both sides. A mask adjusted too tightly may cause a channel at the edge of the facepiece through which the gas may enter. Each of the opposing head harness straps must be tightened the same amount to keep the headpad centered. Tightening the head harness must be carefully done because if it is adjusted too tightly, headaches and discomfort on prolonged wearing may result.

Second.—If adjustment of the head harness fails to stop the leak, it is possible that a hole or rip in the hose, outlet valve, or facepiece may have developed and a minute visual inspection of the gas mask as prescribed in paragraph 91 is necessary.

4. Outlet valve ports occasionally stick and cause exhaled air to pass out between the facepiece and the face, especially during very cold weather or after the mask has been disinfected. In case of a sticking outlet valve, gently massage the valve ports with the thumb and fingers, with the mask adjusted to the face. If the valve still fails to operate, remove the facepiece and open the valve ports with a match stick, but be careful that the valve is not injured or torn in so doing. Talcum powder sprinkled on the inner surfaces of the outlet valve will prevent further sticking. Readjust the facepiece.

5. If visual mask inspection is to be performed, the carrier is not fastened.

■ **91. MASK INSPECTION.**—Checking the mask as described in paragraph 90 is not a conclusive test of its serviceability. During the execution of the command **CHECK MASK**, if the facepiece fails to cling to the face and a leak is indicated, a minute visual inspection must be made. Visual inspections must also be made upon receipt of the masks and periodically thereafter for cleanliness and condition of the several parts of the gas mask. This inspection is made by the individual wearer. It is not executed as a precision drill, but will be taught in the following manner:

a. To inspect mask.—The command is: 1. **INSPECT**, 2. **MASK**. Remove facepiece from carrier or face and hang it over left shoulder. Unfasten upper canister strap and remove the canister from the carrier. Examine canister straps and check antidim. Examine canister. (See note 1 below.) Examine hose. (See note 2 below.) Replace canister in carrier, making sure that nozzle elbow points to the front and that canister is correctly seated in the pocket formed by lower canister strap. Refasten upper canister strap. Minutely and carefully examine the outlet valve, angletube assembly, facepiece, and head harness. (See notes 3, 4, 5, and 6 below.) Persons with defective or faulty masks will report to the instructor; all others will replace facepieces as prescribed in paragraph 89.

NOTES.—1. Serious defects in the canister are indicated by holes through the canister body, excessive rust and corrosion, and by loose or rattling contents. (Normally, the canister does not make any sound when shaken.) Rust or corrosion may be caused by water in the interior of the canister, resulting in caked and damaged chemicals. This will lower the chemical efficiency and cause marked increase in breathing resistance. Such a canister will be exchanged. Minor defects in the canister are faulty inlet valves and loose connections to the hose. These can be repaired in the organization.

2. Hose may develop holes, splits, and tears due to accident. These may be temporarily patched in the field in an emergency but should be replaced as soon as possible. Improper storage and incorrect placement of the hose in the carrier often cause kinks, undue stretching or tackiness, and permanent set of the rubber. Such hose should be replaced.

3. Outlet valves often develop pinholes and splits near the point of junction with the angletube. To find these, gently distend the rubber and examine it closely for cracks. Outlet valve ports may become torn. If incorrectly stored, the rubber may become sticky or tacky and later hard and cracked with a permanent set. Defective valves will be replaced. Occasionally after disinfection, and also during freezing weather, the valve ports or edges of the valve disk will freeze or stick, causing very high resistance to exhalation. When this happens, it is necessary to examine the valve and carefully open the ports or disks.

4. In the diaphragm mask, check the diaphragm to see that it has no holes and that the mount forms a gastight seal.

5. Chief defects occurring in angletubes of service masks are loose or missing outlet valve guard parts and insecure connections to the hose or facepiece. Any of these can be repaired easily.

6. Facepieces are affected by improper storage and careless use. The rubber may, unless correctly placed in the carrier, take a permanent set and form leakage channels around the edges. Head harness attachments may become torn or loosened. Cracks and

splits sometimes develop near the eyepieces. Eye lenses sometimes are accidentally broken. Unless the damage is too great, facepieces usually can be repaired within the organization.

7. If head harness is adjusted too tight or with too great tension during drills and wearing exercises, the rubber threads of the elastic straps may break. Improper storage may cause the rubber threads to deteriorate and lose elasticity. A defective head harness should be replaced.

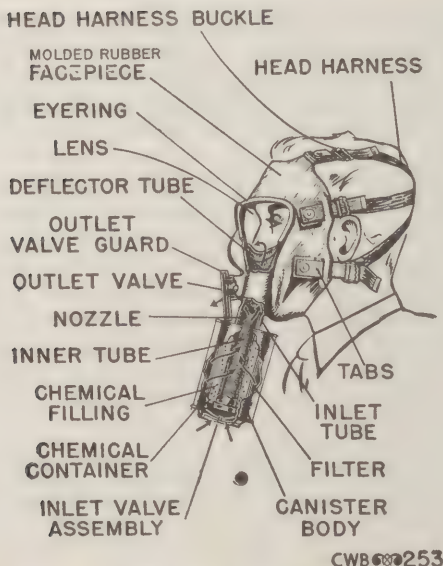
b. To inspect carrier.—With mask unslung (fig. 20) and held in the left hand, the command is: 1. **INSPECT**, 2. **CARRIER**. At the command **CARRIER**, open the flap. Visually examine the carrier outside to see that the straps, slides, eye clasps and hook clasps, and snap fasteners are complete, and the carrier body clean and in serviceable condition. Examine the interior to see that the antidim is present and that canister straps and snap fastener are serviceable. Make sure that facepiece and hose are correctly placed in the carrier without distortion.

NOTE.—Inspection of the carrier is habitually performed whenever the mask is to be laid away and not placed in company storage racks. The carrier may also be inspected at such other occasions as deemed necessary.

SECTION III

TRAINING GAS MASK

■ 92. **CONSTRUCTION AND LIMITATIONS.**—*a. Facepiece.*—The facepiece of the training mask is of a universal size, fully molded of rubber with integrally molded air supply tubes and deflectors (fig. 50). Eyepieces are shaped to give the maximum amount of vision and are crimped on. Head harness attachments and tabs are riveted to the facepiece by countersunk rivets. Face pieces have been shaped to provide the least amount of dead air space within the mask. Three training types are furnished, differing only in construction of the outlet valve. One type is known as the mask, training, M2, and is equipped with outlet valve MIV, which consists of a molded rubber valve seat and a circular rubber disk attached by means of a rubber stud. The second type is known as the mask, training, M2A1, and is assembled with outlet valve MV, which is a modification of the standard outlet valve for the service mask (fig. 51). Figure 52 illustrates the third type of valve, M8, of molded plastic construction.



CWBC 253

FIGURE 50.—Training mask—cross section.

b. Canister.—The canister for the training mask is cylindrical in shape and contains a filter and chemical filling similar to the standard service canister. The air enters through an inlet valve and passes through the canister to the facepiece. When it enters the facepiece, it is conducted to the eyepieces by means of channels molded in the facepiece and is deflected over the eyepieces by means of ports, thus decreasing the tendency to fog. Nomenclature is shown in figure 50. The air is inhaled directly from the inside of the facepiece.

c. Carrier.—The carrier is a lightweight cloth bag furnished with a single adjustable shoulder strap and closed by means of a snap fastener. A body cord permits tying the carrier to the waist.

d. Limitations and use.—Training masks are intended for training purposes only. Their life is less than that of the latest standard canister, being only about 13 hours in an average concentration of gas, compared to the standard



① MIV valve.

② MV valve.

FIGURE 51.—Outlet valves on training masks.

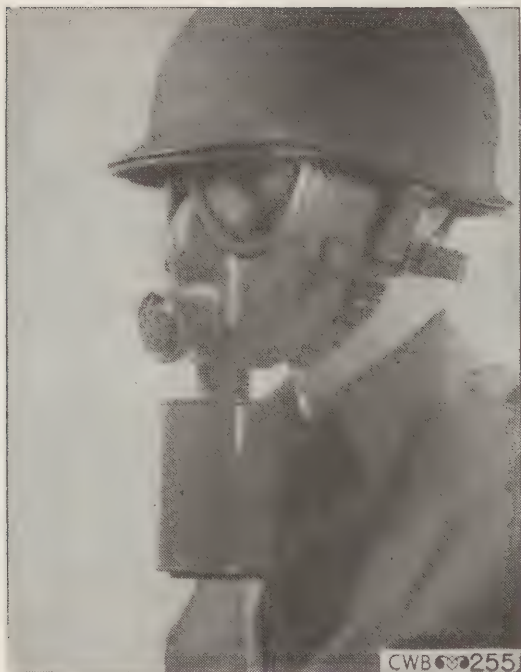


FIGURE 52.—M8 valve on training mask.

canister which protects for about 40 hours. However, the training canister will protect against all standard chemical agents. The amount of protection furnished against the standard casualty agents is equal to that of many of the canisters used in World War I, and is superior in the case of

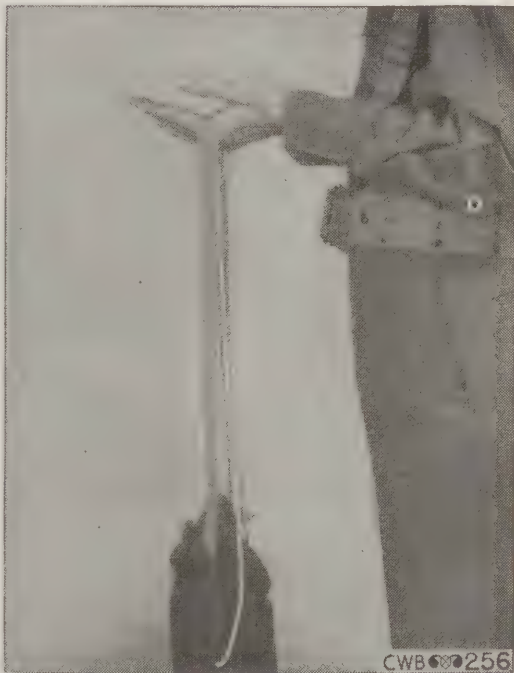


FIGURE 53.—Slinging mask—first position.

irritant smokes. Resistance of the training canister is slightly greater than the standard service canister, but less than the World War types. In case of emergency it can be used for protection against a chemical attack. This gas mask must not be used around fires, within buildings where exhaust motor fumes or carbon monoxide is present, in inclosed spaces

where the oxygen content of the air may be too low to support life, or where concentrations of toxic gases are too high. Training masks must not be used for fumigation work.

■ **93. GAS MASK DRILL.**—Drills for the training mask follow as closely as possible the drills set up for the standard service mask (pars. 86 to 91, incl.), considering the differences in

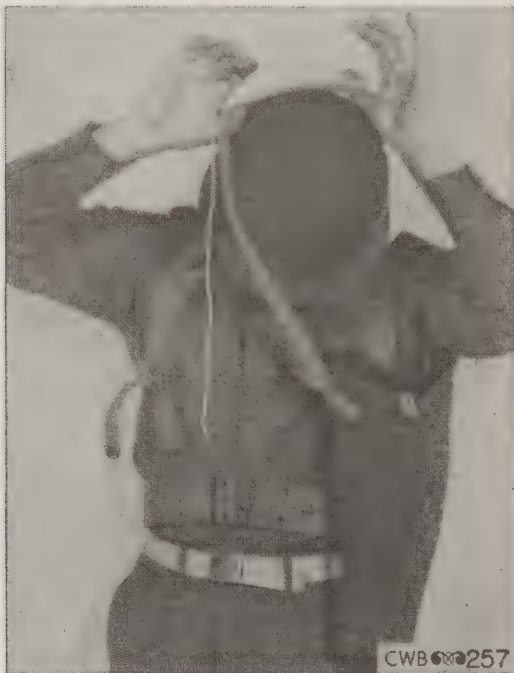


FIGURE 54.—Slinging mask—second position.

construction. In general, the notes describing the movements and commands for the standard masks apply to the movements for the training mask. Where these differ, supplemental notes will be found in the following drill procedures:

a. To sling the mask.—The command is: 1. SLING, 2. MASK. At the command, MASK, hold the carrier by shoulder

strap in the left hand (fig. 53), the flap of carrier facing away from the body. The body cord is placed over the strap in the hand. With both hands, grasp top of shoulder strap. Swing strap over the head, at the same time passing left elbow through loop (fig. 54). Place strap at junction of neck and right shoulder. Straighten out strap. Tie the body cord,

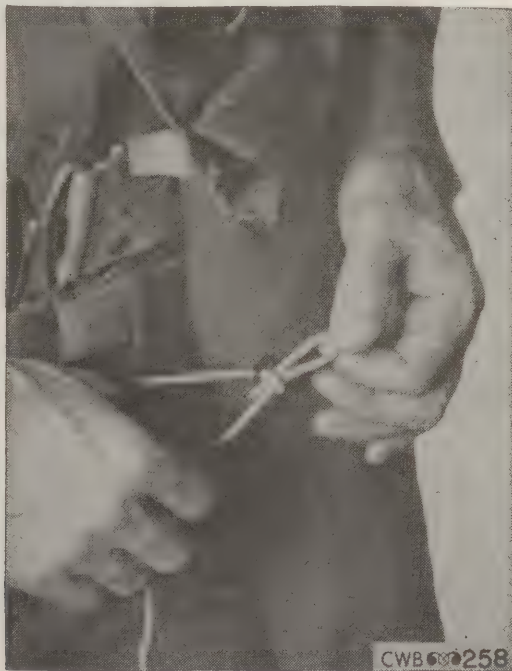


FIGURE 55.—Tying waist cord.

using a bow knot which can be easily untied to unsling carrier (fig. 55). When either full field or light pack is worn, the training mask carrier is slung over equipment. To sling or unsling the pack, shift the carrier to the front of the body, keeping the carrier strap over the neck.

b. To unsling the mask.—The command is: 1. **UNSLING**, 2. **MASK**. Unfasten body cord. With both hands, grasp shoulder strap and raise and slide over the head. Hold shoulder strap in left hand with the flap of carrier away from body.

■ 94. To **ADJUST THE MASK**.—The mask being slung, the command is: **GAS**. At the command **GAS**, dispose of arms and equipment. Remove head covering. Hold bottom of carrier



FIGURE 56.—Removing mask from carrier.

with left hand and open flap with right. Grasp top of facepiece with right hand (fig. 56). Bring facepiece smartly out of carrier and grasp with both hands, sliding the thumbs up and under the lower and middle head harness straps, fingers

extended on outside of facepiece almost above the eyepiece. Flip the head harness out of the facepiece if necessary. Bring facepiece up in front of the face. Thrust out chin (fig. 57).

TWO. Seat chin pocket of facepiece firmly on the chin, holding the head stationary. Sweep head harness smoothly



FIGURE 57.—Thrust chin forward.

over the head without twisting straps, and center the headpad (fig. 58). Beginning at the chin, and with an upward and backward sweeping motion of the palms, press edges of facepiece smoothly on the face.

THREE. Place left palm over outlet valve, make sure it is closed (fig. 59), and exhale vigorously to clear any gas from inside of facepiece. Check mask by gripping the canister with

the left hand and placing the palm of the right hand over the inlet valve. Inhale. No air should enter, and the facepiece should collapse against the face (fig. 60). (See par. 97.)

FOUR. Replace headpiece. Fasten carrier flap and resume original position.

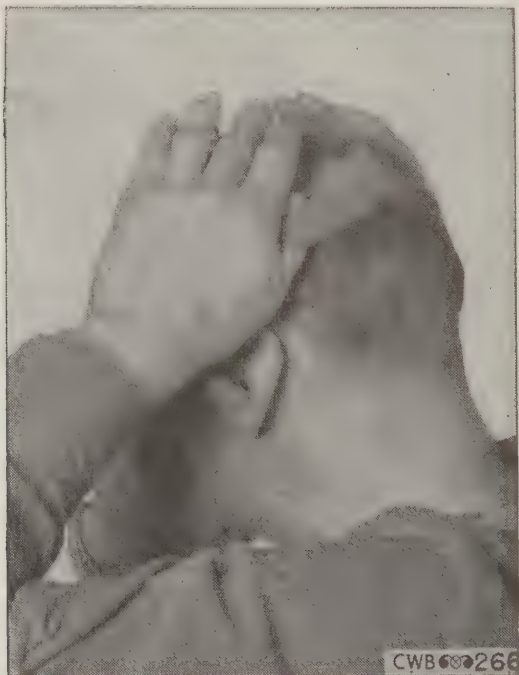


FIGURE 58.—Sweeping head harness over head.

NOTE.—Without the numbers and at command GAS, immediately stop breathing. Do not take another breath (even if the breath has just been exhaled) until the facepiece is adjusted and cleared (fig. 18).

■ **95. TO TEST FOR GAS.**—The facepiece being adjusted, the command is: **TEST FOR GAS.** Take a moderately full breath, exhale part of the air breathed, and stop breathing.

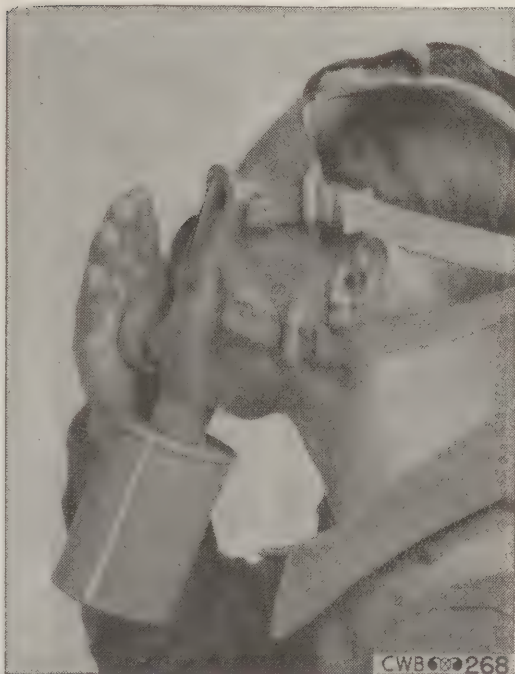


FIGURE 59.—Clearing mask.

Stoop to bring the face as close to the ground as possible without touching any part of the person or equipment to the ground. Insert two fingers of the right hand between face and facepiece near the cheek to permit air to enter at that point. Sniff gently but do not inhale. Resume the erect position. Clear the facepiece as prescribed in the adjustment for the count of **THREE** (fig. 59). Resume normal breathing.

■ **96. TO REMOVE AND REPLACE MASK.**—The command is: 1. **REMOVE AND REPLACE**, 2. **MASK**. At the command **MASK**, test for gas as prescribed in paragraph 95. Remove headpiece with left hand. Grasp facepiece at junction of facepiece and canister with the right hand, and with a downward, outward,

and upward motion remove facepiece. Place facepiece up under left arm. Replace headpiece using both hands. Grasp facepiece at junction of facepiece and canister with the right hand and hold chest high in front of body.

TWO. Fold head harness inside the facepiece. With the right hand, which is holding the mask, steady the carrier, and

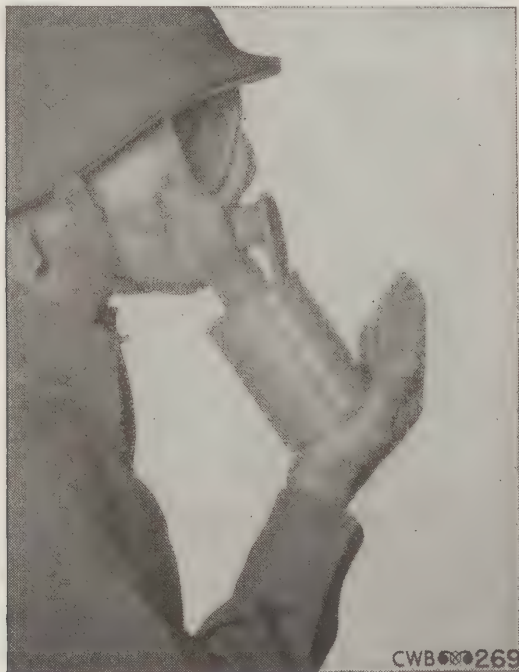


FIGURE 60.—Checking mask.

with the left hand open carrier flap. Hold carrier open with left hand and start canister into the carrier, the eyepieces to the front.

THREE. Using both hands, slide mask into carrier without forcing (fig. 61). With both hands, close flap of carrier. Resume original position.

■ 97. To CHECK FIT OF MASK.—The mask being adjusted, the command is: 1. CHECK, 2. MASK. At the command MASK, grasp the canister with the left hand, place palm of right hand over inlet valve, make sure it is closed, and inhale deeply. No air should enter and the facepiece should collapse against the face (fig. 60).

NOTES.—1. Masks should be habitually checked each time after adjustment.

2. CHECK MASK is performed as a part of inspection in ranks (see par. 105).

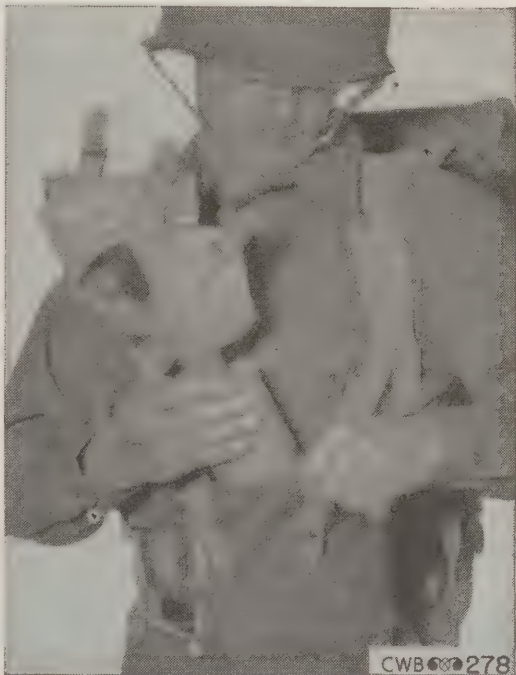


FIGURE 61.—Placing canister in carrier.

3. Instructions for fitting and adjusting masks are in paragraphs 90 and 106.

4. If visual mask inspection is to be performed, the carrier is not fastened.

5. When the toque and/or hood are worn, certain modifications of gas mask drill are necessary. These variations follow:

a. *To adjust mask.*—Same directions as in paragraph 87, note 10, with the exception that when toque cannot be opened about the neck, it should be removed and placed in helmet. Adjust the facepiece and then insert the canister and outlet valve through the neck of the toque and out the face opening. Pull toque up over head with canister on the outside of toque (fig. 62). Replace headgear as in paragraph 87, note 10.

b. *To test for gas.*—Same as paragraph 87, note 10.

c. *To remove mask.*—Remove helmet hood and toque as in paragraph 87, note 10, with the exception that the toque which does not open at the neck should be removed and placed in helmet before removing mask. Return mask to carrier and replace headgear.

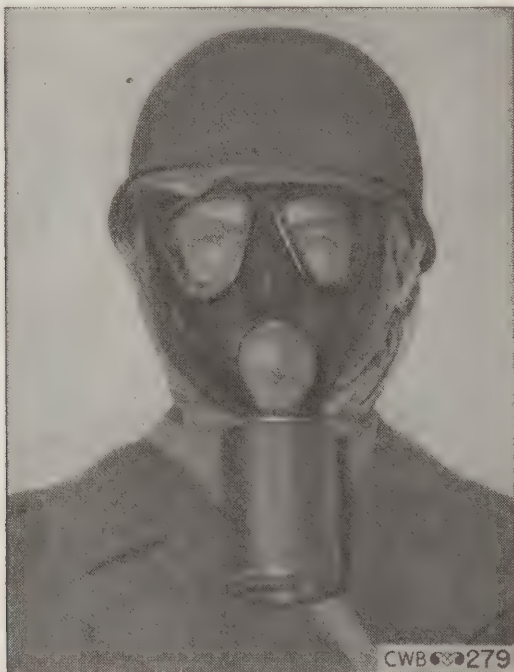


FIGURE 62.—Toque and hood.

■ 98. MASK INSPECTION.—Checking the mask as described in paragraph 97 is not a conclusive test of its serviceability. During the execution of the command CHECK MASK, if the

facepiece fails to cling to the face and a leak is indicated, a minute visual inspection must be made. Visual inspections must also be made upon receipt of the masks and periodically thereafter for cleanliness and condition of the several parts. This inspection is made by the individual wearer. It is not executed as a precision drill. If air leaks out around the edges of the mask after resumption of breathing, a sticking outlet valve is indicated. Remove facepiece and carefully open valve disk if an MIV valve, or open valve ports if an MV valve. In the case of an M8 valve, unscrew the plastic guard and loosen rubber valve. Replace the plastic guard after valve functions properly.

a. To inspect mask.—The command is: 1. INSPECT, 2. MASK. Remove facepiece from carrier or face. Examine canister. Examine outlet valve. Minutely examine facepiece and head harness. Inspect carrier without unslinging. Replace facepiece in carrier.

NOTE.—Sources of trouble in the training mask are at the connections of the facepiece to the outlet valve and to the canister nozzle, and cracks and splits near eyepiece binder rings and near the rivets which secure the head harness chapes. The elastic webbing of the head harness deteriorates very rapidly and must be inspected frequently. Holes and cracks in the facepiece may be patched. Head harness may be replaced.

b. To inspect carrier.—The mask being unslung, the command is: 1. INSPECT, 2. CARRIER. Open carrier flap. Examine outside of the carrier for condition, cleanliness, and completeness. Look inside the carrier to see that the facepiece is correctly placed within. Refasten the flap.

NOTE.—Inspection of the carrier is habitually performed whenever the mask is to be laid away and not placed in company storage racks. The carrier may also be inspected at such other occasions as deemed necessary.

SECTION IV

OPTICAL GAS MASK

■ 99. GAS MASK DRILL.—Preliminary drills will be by the numbers in order to acquire completeness and accuracy in adjustment of the mask and to habituate the individual in its correct manipulation. Proficiency in this drill will be

followed by training without the numbers to insure rapidity of adjustment. The drill will be executed at ease. Training in holding the breath will also be included, but it applies only to drill without the numbers.

a. To sling the mask.—The command is: 1. SLING, 2. MASK. Hold the carrier by the shoulder strap in the palm of the



FIGURE 63.—Slinging mask—first position.

left hand, flap of carrier away from the body (fig. 63). Place the shoulder strap over the left shoulder. With both hands grasp the clasp.

TWO. Unfasten the clasp with the right hand (fig. 64), raise the strap and pass it behind the head (fig. 65), and then down over the right shoulder. Fasten the clasp (fig. 66). Straighten strap if necessary. Push carrier back of left arm (fig. 67).

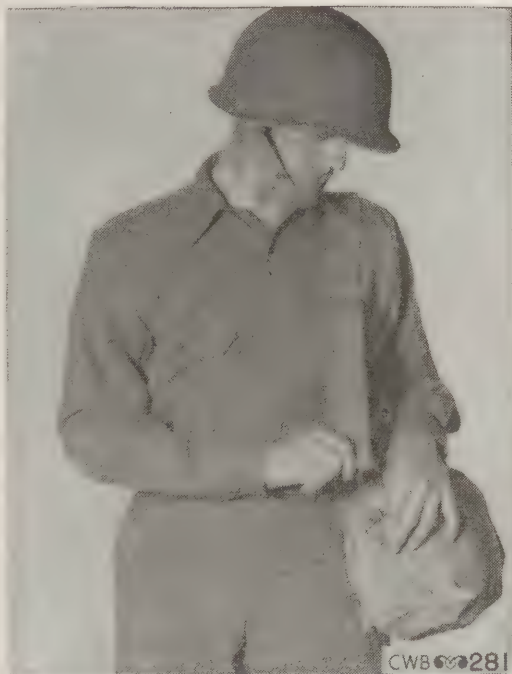


FIGURE 64.—Slinging mask—second position.

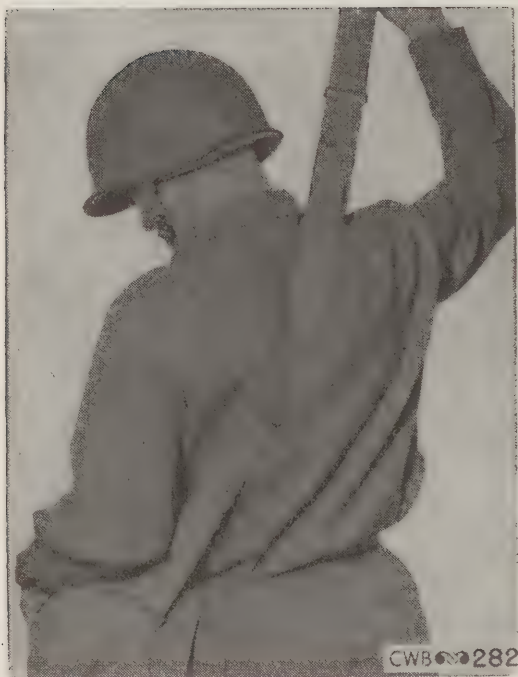


FIGURE 65.—Slinging mask—third position.

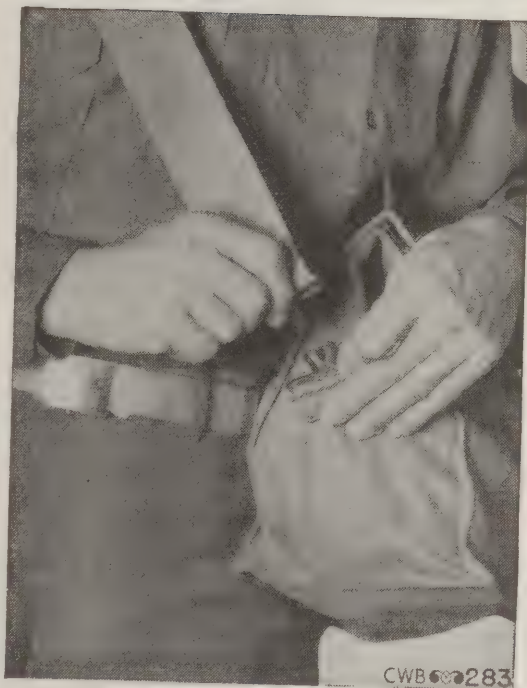


FIGURE 66.—Fastening clasp.



FIGURE 67.—Push carrier back of left arm.

b. To unsling the mask.—The command is: 1. UNSLING, 2. MASK. With both hands unhook the shoulder strap clasp. Raise the strap and pass it behind the head (fig. 68) and down over the left shoulder. Fasten the clasp (fig. 69). Remove strap from left shoulder and hold it in palm of left hand with carrier flap to the front (fig. 63).



FIGURE 68.—Unsling mask—first position.

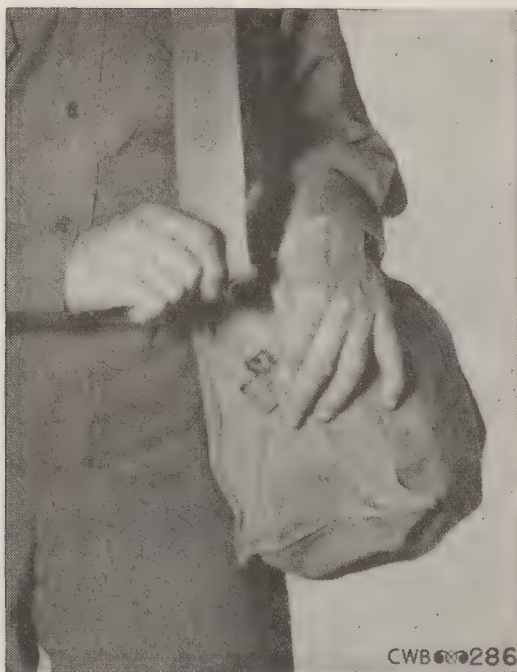


FIGURE 69.—Fastening clasp—second position.

■ 100. TO ADJUST THE MASK.—The mask being slung, the command is: GAS. At the command gas, dispose of arms, etc. Remove and dispose of head covering (fig. 70) and slide the carrier forward in front of left hip. Hold it at the bottom with the left hand and open flaps with the right hand (fig. 71). Remove the mask by grasping diaphragm assembly and withdrawing straight up (fig. 72). Hold facepiece by diaphragm assembly with outlet valve to the front. With the left hand grasp the canister (fig. 73) and drop the facepiece forward retaining grip on canister (fig. 74). Grasp hose and lower head harness strap together on right side with right hand; same on left side with left hand (fig. 75). Raise facepiece face high; thrust chin forward. Extend lower three

fingers to raise canister pad, maintaining grasp on hose and lower head harness strap with index finger and thumb (fig. 76).

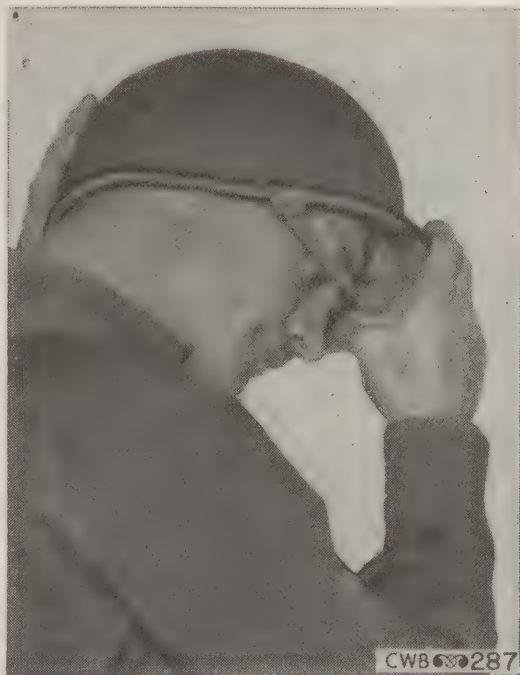


FIGURE 70.—Removing headpiece.



FIGURE 71.—Opening carrier.

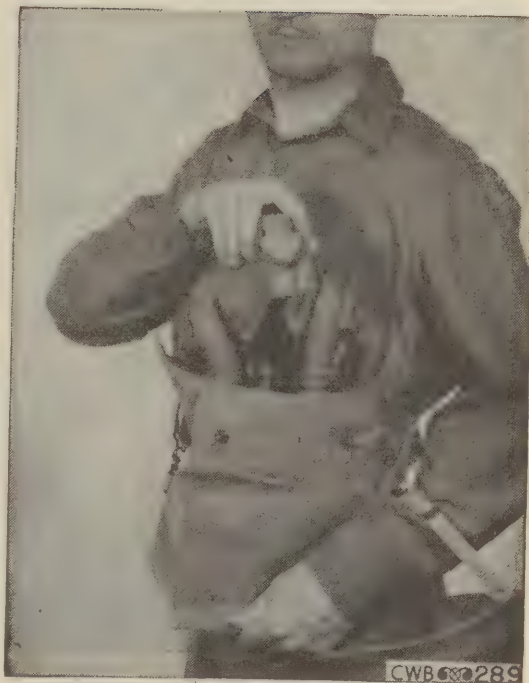


FIGURE 72.—Withdrawing mask from carrier.



FIGURE 73.—Adjusting mask—first position.

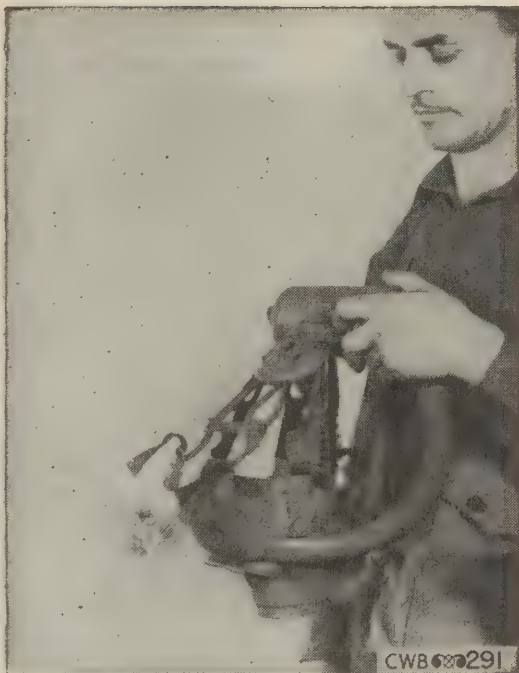


FIGURE 74.—Adjusting mask—second position.



FIGURE 75.—Placing fingers under head harness.



FIGURE 76.—Thrust chin forward.

TWO. Seat facepiece firmly on chin and move canister and head harness into place with an upward backward sweep of the hands. Seat head harness and canister pad and smooth out edges of the facepiece (fig. 77).

THREE. Close outlet valve with two fingers of the right hand, pressing the valve against the chin, and clear the facepiece by exhaling vigorously (fig. 78). Check mask by pinching both hoses to shut off the air supply. (See par. 103). No air should enter and the facepiece should collapse against the face (fig. 79).

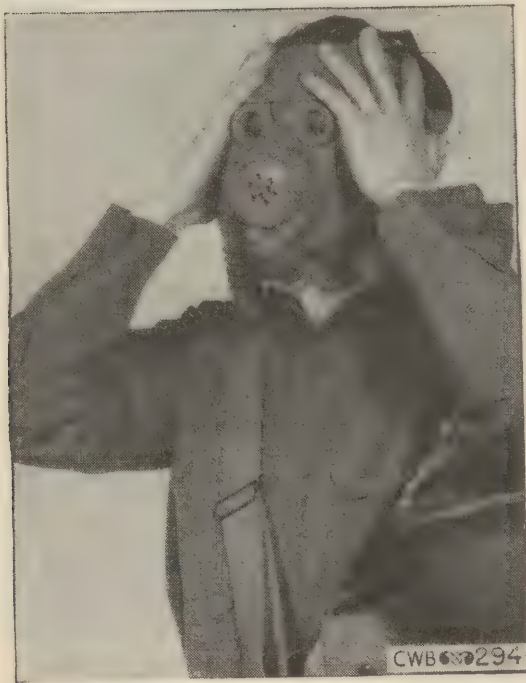


FIGURE 77. —Pressing mask to face.



FIGURE 78.—Clearing mask.



FIGURE 79.—Checking mask.



FIGURE 80.—Optical mask adjusted.

FOUR. Replace headpiece. Fold inner flaps in and fasten the outside flap. Resume original position (fig. 80).

■ **101. To TEST FOR GAS.**—The facepiece being adjusted, the command is: **TEST FOR GAS.** Take a moderately full breath, exhale part of the air breathed, and stop breathing. Stoop to bring the face as close to the ground as possible without touching any part of the person or equipment to the ground. Insert two fingers of the right hand between face and facepiece near the cheek to permit air to enter at that point (fig. 81). Sniff gently but do not inhale. Resume the erect position. Clear the facepiece as prescribed in the adjustment for the count of **THREE.** Resume normal breathing.



FIGURE 81.—Testing for gas.

■ 102. TO REMOVE AND REPLACE MASK.—The facepiece being adjusted, the command is: 1. REMOVE AND REPLACE. 2. MASK. First, test for gas as prescribed in paragraph 101 (fig. 81). If no gas is detected, lift the headpiece with the left hand and with right hand grasp the diaphragm assembly (fig. 82). With a downward, outward, and upward motion, remove the facepiece (fig. 83). Hold the facepiece in crook of left arm and replace headpiece, using both hands (fig. 84). Regrasp mask by diaphragm assembly (fig. 85), and bring to a position in front of the body, rotating it so that the outlet valve is to the front (fig. 86).



FIGURE 82.—Removing mask—first position.



FIGURE 83.—Removing mask—second position.



FIGURE 84.—Replacing headpiece.



FIGURE 85.—Regrasping mask by snout.



FIGURE 86.—Holding mask in front of body.

TWO. With left hand, pull carrier to a position in front of the left hip. With the right hand, which is holding the mask, steady carrier against hip and, with left hand, open carrier flap and spread open carrier (fig. 87). Hold facepiece above carrier opening (fig. 88).



FIGURE 87.—Opening carrier.



FIGURE 88.—Replacing mask.

THREE. Start canister through carrier flaps and push to bottom of carrier with left hand (fig. 89). By shaking carrier with both hands, settle hose and facepiece into position in carrier (fig. 90). Refasten carrier.

■ **103. To CHECK FIT OF MASK.**—The mask being adjusted, the command is: 1. CHECK, 2. MASK. At the command MASK with the thumb and first two fingers of each hand, pinch the walls of the hose tubes together between the canister and the facepiece connections (fig. 79). Inhale. The facepiece should collapse against the face and no air should enter. (See par. 106 for further details on fitting and adjusting the mask.)



FIGURE 89.—Replacing mask in carrier.

■ 104. MASK INSPECTION.—Checking the mask as described in paragraph 103 is not a conclusive test of its serviceability. During the execution of the command **CHECK MASK**, if the facepiece fails to cling to the face and a leak is indicated, a minute visual inspection must be made. Visual inspections must also be made upon receipt of the masks and periodically thereafter for cleanliness and condition of the several parts of the gas mask. This inspection is made by the individual wearer. It is not executed as a precision drill, but will be taught in the following manner:

a. To inspect mask.—The command is: 1. **INSPECT**, 2. **MASK**. Remove facepiece from carrier or face. Inspect parts in this order: canister, hose tubes, outlet valve and guard, angletube



FIGURE 90.—Settling mask in carrier.

and diaphragm, facepiece, head harness, canister pad and spring attachment. Hold mask in crook of arm. Inspect carrier without unslinging. Replace facepiece in carrier.

b. To inspect carrier.—The mask being unslung, the command is: 1. **INSPECT**, 2. **CARRIER**. Open the flap. Visually examine the carrier outside to see that the strap, slides, eye clasp and hook clasp, and snap fasteners are serviceable. Make sure that facepiece is correctly placed in the carrier. Refasten flaps.

c. For detailed inspection procedure see paragraph 105.

NOTE.—Inspection of the carrier is habitually performed whenever the mask is to be laid away and not placed in company storage racks. The carrier may also be inspected at such other occasions as deemed necessary.

SECTION V

INSPECTION FORMATIONS

■ 105. **INSPECTION IN RANKS.**—*a. General.*—Each individual is responsible for his gas mask and must see that it is in working order and always ready for service. A daily check and examination by the individual before the gas mask is to be used will be required. In addition, organization commanders will periodically inspect gas masks for condition and cleanliness and, at the same time, the individual will be required to demonstrate by test that his gas mask is correctly adjusted and gas tight.

b. Formal inspection.—Company commanders may inspect gas masks during any formal inspection ceremony and at such other formations as deemed necessary.

(1) *When field equipment is not displayed.*—The company commander commands: **PREPARE FOR MASK INSPECTION.** The company opens ranks as prescribed in drill regulations for the arm or service concerned. As the inspecting officer approaches each person, the facepiece is adjusted and checked by the man. The officer notes the fit and adjustment of the mask. The facepiece is then removed by the individual and handed to the inspecting officer who examines the cleanliness and condition of the facepiece assembly and, if desirable, causes the canister to be removed from the carrier for inspection. The facepiece is replaced in the carrier and the position in the carrier is checked by the inspecting officer.

(2) *When personal field equipment is displayed.*—Upon completion of the inspection of equipment as laid out, the company commander cautions, "Gas masks will be inspected." Platoon commanders command: 1. **SLING**, 2. **MASK**. At this command, individuals sling the carrier. At the approach of the company commander, individuals proceed as indicated in (1) above.

c. Mounted organizations.—Inspection of mounted organizations will include horse mask inspection in accordance with the procedure outlined in paragraph 162.

SECTION VI

FITTING, CARE, STORAGE, AND REPAIR OF GAS MASKS

■ 106. **FITTING.**—*a. Facepiece.*—In order to secure adequate protection, facepieces must fit the wearer. In over 95 percent of the cases the universal size facepiece affords a good serviceable fit and ample protection. In a very small number of cases, faces are too large or too small to be satisfactorily fitted with the universal size. To accommodate this small minority gas masks are manufactured in size 1 to fit small faces, and in size 5 for extra large faces. These sizes will give protection to the few exceptional cases.

b. Fitting.—(1) Center head harness pad and pull well down at back of head with the middle strap clearing the upper part of the ear. This strap should not curve up or down, but should run on a straight line from the facepiece to the head harness pad.

(2) Adjust middle straps only enough to make the buckle lie flat. Be certain that the tension on these straps is equalized. The loose ends should be exactly the same length. Recheck position of head harness pad.

(3) Adjust the two top straps only enough to take up the slack. Recheck position of head harness pad.

(4) Adjust bottom straps to the same tension as top straps. Recheck position of head harness pad.

(5) With the mask in position on the face, place the forefinger of the right hand behind the buckle of the middle strap on the right side of the head harness, and the left forefinger behind the corresponding buckle on the left side. The fingers are *not* placed under the head harness straps. Push the two buckles forward, then let go. The buckles should snap back into their proper positions if the middle straps have been properly adjusted. If the buckles do not snap back, the straps are too loose. Upon completion of adjustment all head harness straps should have the same tension. Recheck the position of the head harness pad.

(6) Make suction test.

NOTE.—The two loose ends of the straps in each pair must be exactly the same length.

c. *Suction test.*—The first check on the fit of the mask is the suction test described under the command CHECK MASK in paragraphs 90, 97, and 103. If the facepiece fits properly, it will cling to the face and the wearer will be unable to get air. If the fit appears to be satisfactory as a result of this test, it should then be tested in the gas chamber.

■ 107. GAS CHAMBER TEST FOR FITTING.—*a. Testing in gas.*—Before any gas mask is used for protection against a lethal gas or irritant smoke, inspection of the mask will include a man test in a lacrimatory atmosphere to detect any leaks that may have resulted from improper assembling or that have developed in storage from age or deterioration of components. A gas chamber is used for this purpose. Such a chamber consists of a room or other inclosure into which a chemical agent may be readily introduced and in which gas masks may be tested on the wearer. A lacrimator is used in a concentration which will cause only momentary discomfort if leakage or improper fitting is encountered. However, troops should be thoroughly trained in gas mask drill before the gas chamber exercise.

b. Gas chamber.—Any reasonably airtight room or inclosed space of moderate size will serve as a gas chamber. As a safety precaution the chamber should be from 100 to 200 yards away from any other place where personnel will likely congregate. It is desirable that the room be well lighted both naturally and artificially. A two-room building with each room approximately 25 feet square, of rough timber, covered with tar paper and with two doors for each room, is large enough for a brigade. A standard two-room gas chamber may be constructed according to Construction Quartermaster Drawing, Plan No. 700-278. With nothing better available, a pyramidal tent may be used. If it is desired to put the tent eventually in storage, it should be turned wrong side out and left in the sun and wind for several days before storing to rid it of any agent.

c. Gas chamber exercise.—The objective of the gas chamber exercise is to instill confidence in the mind of the soldier in the protection afforded by the gas mask, and thereby to dispel any fear that he may have of being in the presence of

gas in combat. It is the only conclusive proof of the correct fit of the mask and the ability of the man to adjust and clear his mask properly while in the presence of gas. This exercise is divided into four phases. In phase I a check of the fit of the mask is obtained in the presence of gas. Phase II proves to the soldier that his mask is actually furnishing him protection against a potent agent. Phase III gives training in testing for gas. Phase IV instills confidence in each man as to his ability to adjust his mask, in a toxic atmosphere, thus dispelling his fear of gas.

(1) *Phase I.*—(a) Fill the gas chamber with an effective concentration of tear gas (chloracetophenone, CN). For every 100 cubic feet of space in the chamber use one CN capsule. Place the capsule on top of an inverted tin can which has had holes punched in the sides (fig. 91), and heat it with a lighted

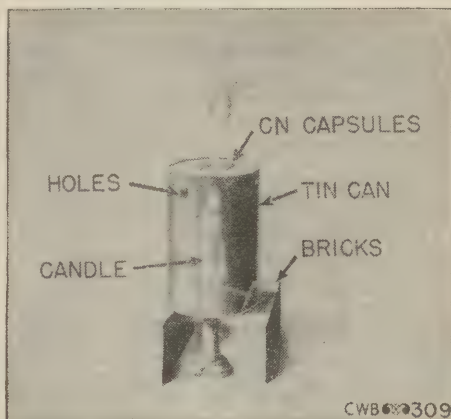


FIGURE 91.—CN generator.

candle placed underneath the can until the tear gas is volatilized. Add additional capsules from time to time to maintain the original concentration. Before the men enter the chamber, put them through the gas mask drill until satisfied that all are protected. Men wearing their masks are then sent into the chamber in groups of ten or more. A junior

officer or sergeant takes station inside the chamber. The group stays in the chamber about five minutes, during which period they should execute movements similar to those in combat in order to determine the proper fitting and adjustment of the mask. They do not tamper with the mask. While in the chamber the officer stresses the protection the mask is affording.

(b) On emerging from the chamber, the men are moved up wind. They are examined by the officer in charge before they are allowed to remove the mask. He examines the fit of the mask, then orders the masks removed one at a time, and examines each wearer for signs of laceration. Each man is asked whether the mask was comfortable. If he has detected gas while in the chamber, either the head harness must be tightened or a smaller mask used, in which case the test must be conducted again. Masks are then aired until all squads have passed through the chamber.

(2) *Phase II.*—Personnel should gain confidence in the protection afforded by the mask. This may be accomplished by having the individual, properly masked, enter a gas chamber in which a strong concentration of CN has been generated. After remaining in the chamber about 1 minute, each man in turn is told to take a position across the chamber away from the exit and remove his mask and walk toward the exit. The officer stations himself at the exit and assists the man, if necessary, in leaving the chamber. He satisfies himself that each man becomes lacerated.

NOTE.—Do not let troops rub the eyes after this test. Instruct them to separate and face into the wind. After a few minutes, all painful effects of the gas will disappear. Painful swelling of the eyes may result if the eyes are rubbed. As soon as possible, have them wash hands and face with soap and water to relieve the slight discomfort of the gas.

(3) *Phase III.*—Men enter the chamber masked. They are instructed to "Test for gas" and cautioned to clear their facepieces. In this way they learn to detect the odor of chloracetophenone and to force it out of their facepieces. The group then files out of the gas chamber.

(4) *Phase IV.*—A junior officer or sergeant takes his place inside the chamber. Small groups are directed to enter the chamber with the mask carried at the slung position. They

hold their breath and, when well at the far side of the chamber, remove facepieces from carriers and adjust them. The officer or sergeant inside emphasizes the necessity of clearing the mask as the men adjust the facepieces. They remain in the chamber 2 or 3 minutes after adjusting their masks. The group then files out. The inspection officer carefully inspects the adjustment of each mask while on the wearer before permitting removal. Individuals of the group are cautioned not to touch their masks or try to adjust them before the inspecting officer sees them. Faulty adjustment may be indicated by the individual having been gassed or by obvious channels and failure to seat the facepiece to the face, eyepieces not alined with the eyes, and headpad not centered in the rear of the head. Failure of the individual to pass the test indicates inability to adjust his mask properly under conditions of stress. In such cases, more preliminary drill is necessary and the test should be repeated until the desired proficiency is obtained.

■ 108. DISINFECTION.—Whenever masks are stored, exchanged, or used by more than one individual for training purposes, or when the wearer has been suffering from a cold, they should be thoroughly disinfected.

a. Disinfectant, gas mask, M1.—This is a commercial product under the name of Roccal. A 4-ounce bottle containing a 10 percent solution of Roccal by volume is issued each quarter to a company, battery, troop or similar unit. The disinfectant solution is made by adding $1\frac{1}{3}$ ounces from this bottle to a gallon of water (1 part to 100 by volume). This will be enough to disinfect the gas masks of a company. This disinfectant can be used on masks having either plastic or glass eyepieces but should not be used in the presence of soap. It can be applied with small rags such as rifle cleaning patches.

b. Directions.—(1) In disinfecting a gas mask the facepiece should be kept lower than the canister or hose to prevent the disinfectant from running into them. Hold the facepiece in the hand, saturate a small piece of clean rag with the disinfectant, and sponge the entire surface of the facepiece

(fig. 92), including the outer and inner side of the deflector. In this operation the facepiece should not be turned inside out. Then apply the disinfectant similarly to the outside of the outlet valve.

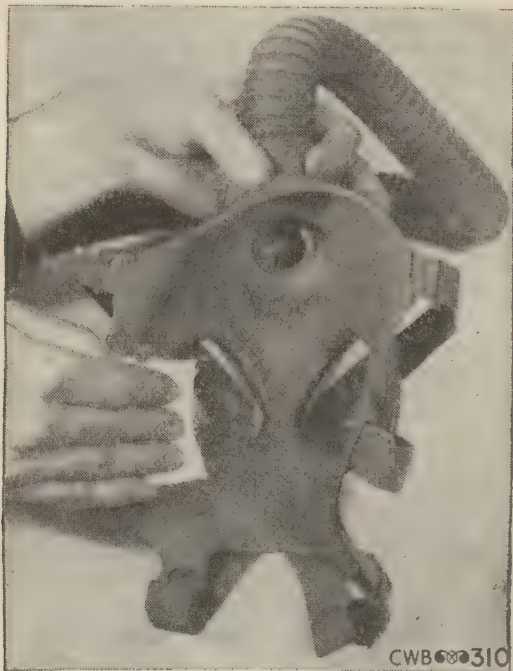


FIGURE 92.—Disinfecting gas mask.

(2) Squeeze a few drops of the disinfectant from the rag into the exit passage of the angletube. Press the sides of the outlet valve with the thumb and finger to let the disinfectant run out. Do not shake off the excess.

(3) Allow all disinfected parts to remain moist for about 15 minutes and then wipe out the inside of the facepiece with a clean, dry rag. The mask should dry thoroughly in the air before it is returned to the carrier.

■ 109. USE OF ANTIDIM.—*a. Purpose.*—Within the service gas mask carrier, held in a loop, is a small can of antidim. The purpose of this compound is to prevent fogging of the eye-pieces.

b. How to apply.—(1) Wipe the inner surface of each eye-piece clean with a soft cloth.

(2) Breathe on the cleaned surfaces and on the piece of antidim to moisten them.

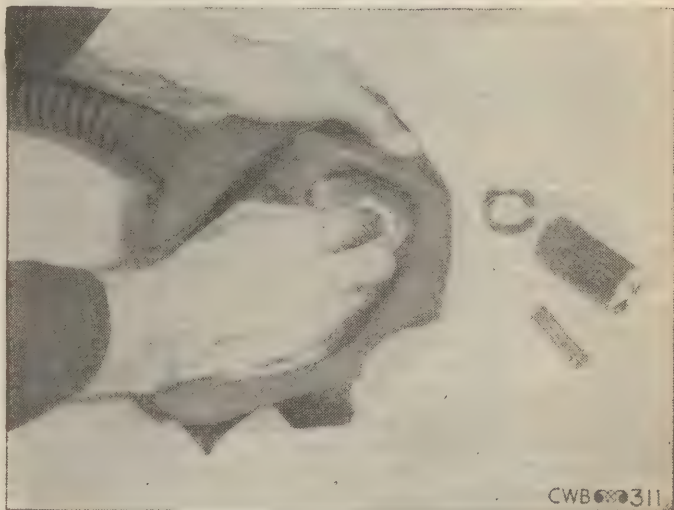


FIGURE 93.—Antidim application.

(3) Rub the antidim twice across the eyepiece.

(4) Again breathe on the eyepiece.

(5) Rub the antidim evenly over the whole surface with the tip of the finger and polish with cloth (fig. 93). Apply antidim in the above manner weekly or after each time the mask is worn. Should the stick of antidim be hard, care should be exercised in applying it to plastic lenses as they are easily scratched.

■ 110. RULES FOR CARE AND USE.—*a. Responsibility.*—Each individual soldier is responsible for the care of his gas mask. No thoughtless abuse or misuse should be tolerated. The soldier should always keep in mind that he must take the best possible care of his mask for it may be the means of saving his life. Gas masks are expensive items of equipment. Their care both as items for training purposes and as articles for the protection of the individual in war is very important. Extreme care will be exercised by commanding officers to insure the extension of their useful life as much as possible. The primary responsibility for the care of the mask rests with the individual to whom it is issued; however, the unit commanding officer is responsible for the general supervision of the care exercised in the use, storage, and repair of all masks within the unit.

b. Care in training.—Gas masks are sufficiently rugged in construction to withstand ordinary use. However, their life will be considerably shortened by improper care and use, and by using the carrier with gas mask in it for purposes other than those intended. Proper care in training requires observance of the following rules:

(1) Keep the head harness just as loose as possible without losing the fit; the tendency is to keep it too tight, thus breaking the elastic or tearing off buckles and tabs. Keep the harness extremely loose in the first drills for recruits.

(2) Do not permit undue stretching of the head harness in putting on the mask. Require trainees to hold firmly to the facepiece until the face is well in the mask.

(3) Do not unnecessarily throw the mask around, or use the carrier as a seat or pillow, or as a receptacle for anything except components of the gas mask.

(4) Do not use the canister under any circumstances to serve as a hammer or for any purpose other than that for which it was designed.

(5) Dry out the mask and carrier immediately after using and before repacking.

(6) Make repairs promptly when they become necessary.

(7) Take special precautions to prevent water from entering the canister.

(8) Do not pile other equipment on top of the mask.

(9) Keep organic solvents, such as acetone, away from masks with plastic lenses.

c. Rules for the individual.—The following rules connected with the use of the gas mask in defense against chemical attack should be impressed upon the individual:

(1) Do not carry anything in your gas mask carrier but the mask.

(2) Do not neglect the gas mask or allow it to receive rough handling.

(3) Do not throw away your gas mask. You may need it later on and it will save your life in a gas attack.

(4) Do not breathe after the gas alarm is given until sure the facepiece is well adjusted to your face and that it has been cleared of gas by blowing vigorously into the facepiece while holding the outlet valve.

(5) Do not remove your facepiece until permission to remove it is given by an officer or a gas noncommissioned officer. In all cases, do not remove your mask until you yourself have tested for gas. *More gas casualties are caused by untimely removal than by failure to adjust the mask.*

■ 111. STORAGE IN ORGANIZATIONS.—*a.* The following rules should be observed in the storage of masks:

(1) Store in a cool, dry place.

(2) Do not store in sunlight or adjacent to steam radiators, stoves, or furnaces.

(3) Do not place in storage when either the mask or carrier is wet or damp.

(4) When the facepiece is in the carrier, keep the hose well rounded in the bottom of the carrier, thus preventing pressure on the hose by the outlet valve guard and subsequent collapse of the hose.

(5) Keep the face form in the facepiece, or in the absence of a face form, stuff the facepiece with newspapers. This prevents creasing.

(6) Keep the mask where it will not be damaged by a blow or heavy weight.

(7) If the rubber in the facepiece becomes sticky in hot weather, sprinkle with talcum powder.

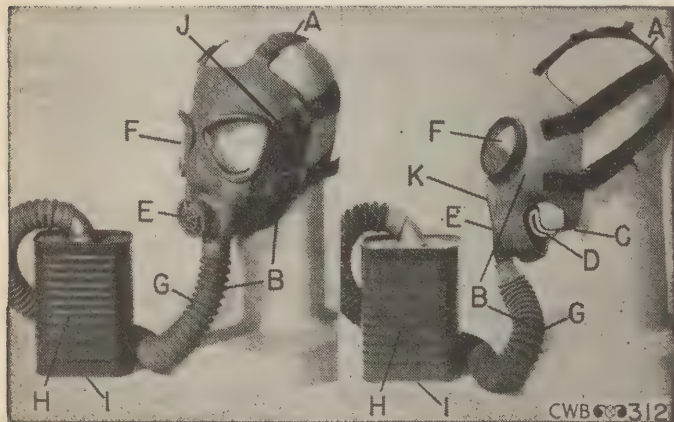
(8) If adhesive tape becomes loose, replace promptly before rust begins on binding wire.

(9) Repaint the canister whenever necessary to prevent rusting.

(10) In storing the training mask or optical mask, essentially the same rules apply. The facepiece is filled out and properly placed in the carrier and hung by the shoulder straps from a hook in a cool, dark closet.

b. When the enlisted man is off duty, his gas mask should be hung at the foot of the bunk or placed in his individual locker so that it is readily available at all times.

■ 112. MINOR REPAIRS.—a. The repairs authorized to be performed by regimental or separate battalion gas noncommissioned officers are illustrated in figure 94.



- A. Change or repair of head harness.
- B. Patch facepiece and hose. (Hose should never be patched unless spares are unavailable and the mask must be used.)
- C. Repair chin seam.
- D. Repair chin rest of diaphragm mask.
- E. Replace outlet valve.
- F. Replace eyepieces (except crimped eyepiece rings).
- G. Replace hose.
- H. Replace canister.
- I. Replace inlet valves.
- J. Replace riveted tabs on molded facepieces.
- K. Replace diaphragm components (except angletube body).

FIGURE 94.—Authorized gas mask repairs.

b. Gas mask repair kits are issued to regiments and separate battalions and contain implements and instructions for the minor repairs listed above. A complete description of these kits and instructions for repair of gas masks are contained in TM 3-205. The repair kit authorized for issue is shown in figure 95. Replacement items (not to exceed 10 percent of masks on hand) will be requisitioned as needed.

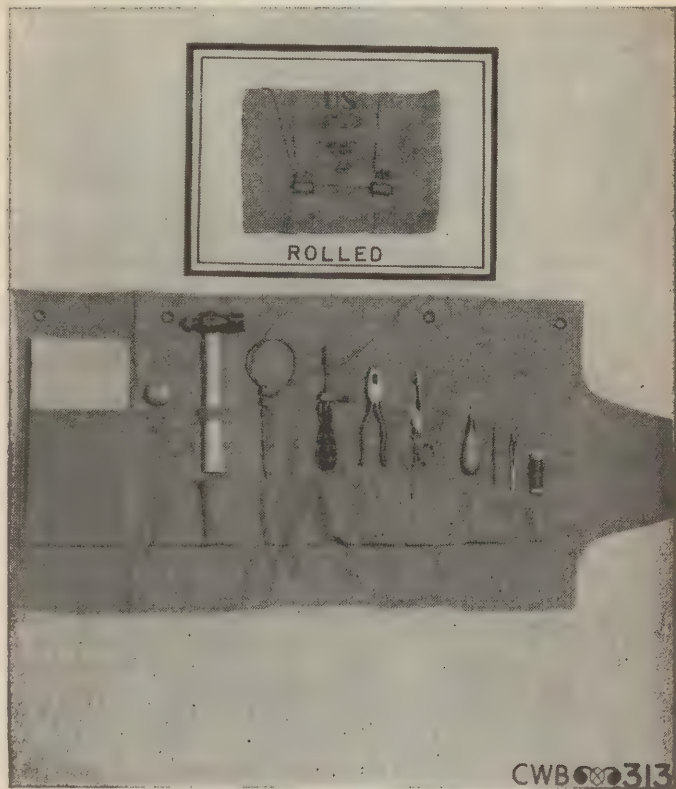


FIGURE 95.—Universal M8 gas mask repair kit.

■ 113. SUPPLIES.—For supply of protective equipment for troops in the theater of operations see FM 3-15. For troops stationed in the zone of the interior, chemical warfare supplies are obtained by requisition on the service installations on which they are based.

SECTION VII

FITTING, ADJUSTMENT, AND WEARING OF PROTECTIVE CLOTHING

■ 114. USE.—Protective clothing (par. 35a) is designed to protect the body against vesicant agents. There are two requirements which govern the kind of protective clothing needed. One requirement is to provide protection for certain personnel engaged in filling operations who might encounter large pools of the liquid or be subjected to sprays of the agent from broken pipes and vessels in case of accidents. The other is to provide protection for personnel required to handle contaminated equipment, engage in decontamination operations, or be protected from vapor or from airplane spray attacks. In the first consideration a complete impermeable suit is required. It is not recommended for any use except in potentially dangerous situations where liquid mustard gas or lewisite in large quantities may likely be encountered. In the second situation permeable protective clothing provides ample protection for all cases where vapor, absorbed mustard gas, or light spray of liquid gas is encountered.

a. Impermeable clothing.—Impermeable suits are made of coated materials which will not allow liquid vesicants or vapors to pass through them. Since there is no circulation of air, the wearer perspires excessively and can wear this covering for only a relatively short time because of exhaustion. There is no satisfactory method of neutralizing liquid mustard gas on the garment and it accordingly must be destroyed when excessively contaminated. (See par. 122.) A suit of impermeable clothing (fig. 96) consists of a one-piece working garment made of impermeable material with an attached hood of the same fabric. Under this suit, protective permeable underclothing and socks are worn. The foot covering consists of treated shoes over which the legs of the

impermeable suit are buckled tightly. Boots of a type of rubber highly resistant to mustard gas or lewisite penetration can be substituted for the shoes, provided the trousers are pulled on over the boot leg. Highly resistant rubber gloves and a gas mask are likewise worn.



FIGURE 96.—Impermeable protective clothing.

b. Permeable clothing.—The permeable type of clothing consists of garments treated in such a manner that they afford reasonably safe protection against vesicant chemical agents in the form of vapor and small drops. The ordinary field uniform can be treated to provide considerable protection, yet permit much comfort and serviceability (fig. 97). However, specially designed garments add greater protec-

tion because of the necessity of covering completely all parts of the skin. Each suit includes one pair of socks, one pair of leggings, one pair of gloves, one pair of drawers, one undershirt, one hood and one one-piece protective suit (coveralls), or one shirt (cotton, khaki, or wool) and trousers or breeches (cotton, khaki, or wool). For protection of the feet, the

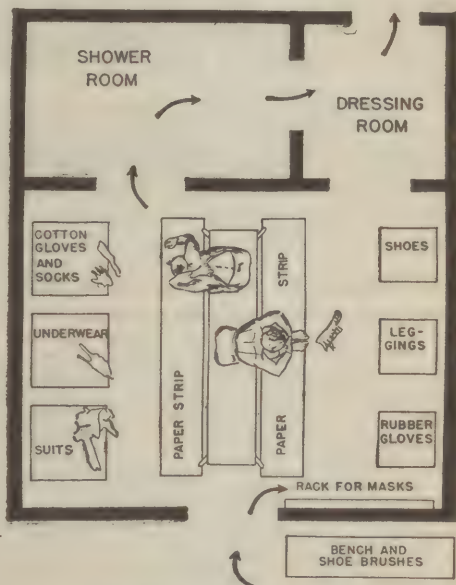


FIGURE 97.—Permeable protective clothing.

wearer treats his footgear with impregnite issued for that purpose (see par. 117). Protection of the hands is afforded by the chemically treated cotton gloves which may be supplemented by outer chemically resistant rubber gloves. For protection of the face, eyes, and lungs, a mask must also be worn.

■ 115. **FITTING.**—Protective clothing will be furnished by the quartermaster in standard sizes. When measuring for leggings it is well to order the next larger size, since they must go over the added thickness of heavy underwear, socks, and coveralls. All other sizes of equipment are supplied in standard measurements.

■ 116. **ADJUSTMENT.**—*a. Dressing.*—In donning protective clothing, the garments will be put on in the following order: undershirt, drawers, socks, coveralls, shoes, leggings, mask, hood, cotton gloves, and finally rubber gloves. Sleeves of both undershirt and coveralls should be pulled well down and covered by the wristlets of the cotton gloves. Hoods should be fastened tightly around the facepiece of the mask so that no vapor can come into contact with the neck or head.



MEN WITH CONTAMINATED CLOTHING

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FIGURE 98.—Protective-clothing dressing room.

The hood is buttoned down to the back of the coveralls so that the neck will be protected.

b. Undressing.—Great care should be exercised in removing protective clothing which has been subjected to possible contamination. In fixed defenses a special room or tent should be provided with a bench upon which to sit (fig. 98). Paper should be placed upon the floor at each side of the bench. All men approach the bench from the same side and, keeping on their chemically treated cotton gloves, remove their leggings and shoes. Then they turn and place their feet upon the paper at the other side of the bench. Without removing their gloves they take off their hoods, masks, and coveralls. The gloves, underwear, and socks are next removed. All clothing is placed in receptacles provided for this purpose. The men then enter an adjacent shower room or field bathing unit and, using plenty of soap, take a thorough bath. Then avoiding the undressing area, they put on clean clothing. This procedure should be followed as closely as possible in the field.

c. Handling contaminated garments.—Attendants should wear protective clothing and gloves. Contaminated garments must be inclosed in airtight bags and sent immediately to an impregnating company for laundering and retreatment.

d. Reissue of cleaned clothing.—Cleaned and retreated clothing is returned to the quartermaster for reissue.

■ 117. APPLYING IMPREGNITE TO SHOES.—*a. General.*—Shoes are rendered resistant to vesicants by applying shoe impregnite furnished the individual soldier. They are not treated originally with the impregnite, hence it is necessary that each individual know how to take care of his own foot covering. Shoe impregnite is issued by the Chemical Warfare Service in 8-ounce cans or collapsible tubes.

b. Directions.—The impregnite is applied to ordinary issue field shoes. To apply the impregnite properly, the shoes are cleaned, the laces removed, and the impregnating paste rubbed thoroughly upon both the inside and outside surfaces (fig. 99). The upper leather is flexed vigorously for about 15 minutes, keeping an excess of impregnite upon the shoe at all times. The shoes should be allowed to stand for a few hours

before being worn. Laces are also impregnated. New shoes are given two treatments about 12 hours apart before they are worn the first time. Any excess surface impregnate is wiped off. Shoes are treated at least once a week, and thus treated will effectively protect the wearer from injury by vesicant agents.

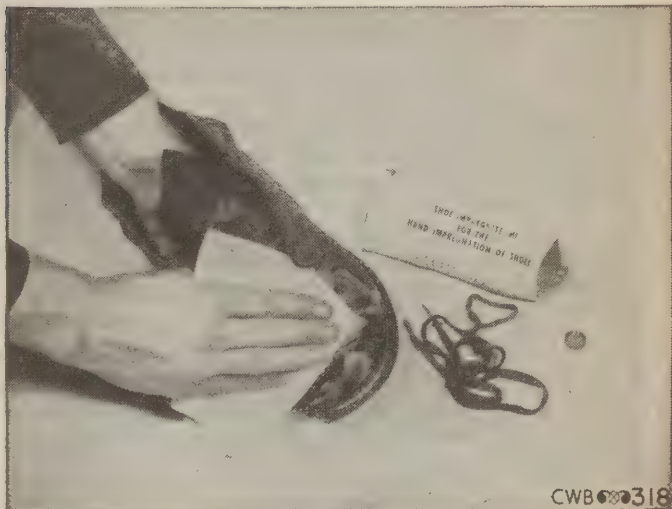


FIGURE 99.—Shoe impregnate.

■ 118. RULES FOR INDIVIDUAL CARE.—*a. Contamination.*—The individual should avoid contact with liquid mustard gas on vegetation even when wearing permeable protective clothing.

b. Chlorinated lime.—Special care should be exercised by personnel to prevent chlorinated lime in any form, either solid or slurry, from coming into contact with permeable protective clothing as the chloride of lime will destroy fabric.

c. Organic solvents.—Contact with organic solvents such as alcohol and gasoline should be avoided.

d. Holes.—Care should be taken that no tears or holes are made in garments through which vesicant vapors might reach the body.

e. Examination before wearing.—Men should inspect each garment before wearing it to insure there are no holes.

■ 119. STORAGE.—Protective clothing should be stored in a cool, dry, well-ventilated storeroom. Impermeable clothing should be stored without folding so far as possible, since folding will crease the cloth and tend to break the material, thereby causing leaks. In the field these storage conditions should be followed as closely as facilities permit.

■ 120. MINOR REPAIRS.—*a. Permeable clothing.*—When holes or tears are detected in permeable garments they should be carefully patched with the same type of material. The mending material must be chemically treated to prevent vapors penetrating through the repairs.

b. Impermeable clothing.—Impermeable clothing when torn should have a patch of impermeable material sewed firmly in place. Rubber cement may be applied to the under surface of the stitching to make the thread impermeable. Zinc oxide or cellulose tape may be used in an emergency. This is best applied on the under surface also.

■ 121. SUPPLIES.—In the theater of operations articles of clothing in the nature of both impermeable and permeable clothing are designated as class II supplies and replacements are issued accordingly.

SECTION VIII

DECONTAMINATION OF CLOTHING

■ 122. AERATION.—If either permeable or impermeable protective clothing has been but slightly contaminated, it may be made safely wearable in a few days by hanging it in the open exposed to sunlight and a free circulation of air. In all cases protective clothing should be hung up to aerate and allowed to dry thoroughly.

■ 123. LAUNDERING.—Impermeable clothing cannot be laundered. Permeable clothing can be successfully cleaned by standard laundering methods, using warm water, however, in-

stead of hot. If the permeable clothing is made of wool, the customary precautions concerning temperature of the wash water will be observed.

■ 124. RETREATMENT.—If permeable garments have been heavily contaminated, they should be laundered and reimpregnated.

■ 125. DECONTAMINATION OF ORDINARY CLOTHING.—Contaminated ordinary clothing may be decontaminated by any one of several methods, and in the following order of effectiveness: laundering with soap and hot water; steaming; subjecting the garments to hot air; or by aeration and sunlight. It should be borne in mind that washing or steaming is likely to cause considerable shrinkage, especially with woollen garments. The time required to treat clothing by the several methods varies from a few minutes in the case of washing to several days in the case of aeration.

a. Washing.—In general, clothing can be decontaminated by laundering in any standard field laundry. Improvised washing may be accomplished by means of hot soapy water in a tub with a hand plunger to insure cleansing action.

b. Steaming.—Improvised steaming is shown in figure 100. If the garments have been exposed to vapor or very minute droplets of vesicant agents, they should be steamed for at least 2 hours; if heavily contaminated, they should remain in the container for from 6 to 8 hours. After steaming, the garments are hung up to dry in the open.

c. Hot air treatment.—If facilities permit, contaminated garments may be hung in a room and subjected to hot air produced by improvised equipment. Treatment is required for at least 4 hours or more for satisfactory results. Fumes from the room must be delivered to the open air in such a manner that personnel are not endangered, and temperatures should be appreciably lower than the scorching temperature of the clothing.

d. Aeration.—The time required for decontamination by aeration will depend upon the temperature, amount of air movement, and degree of contamination.

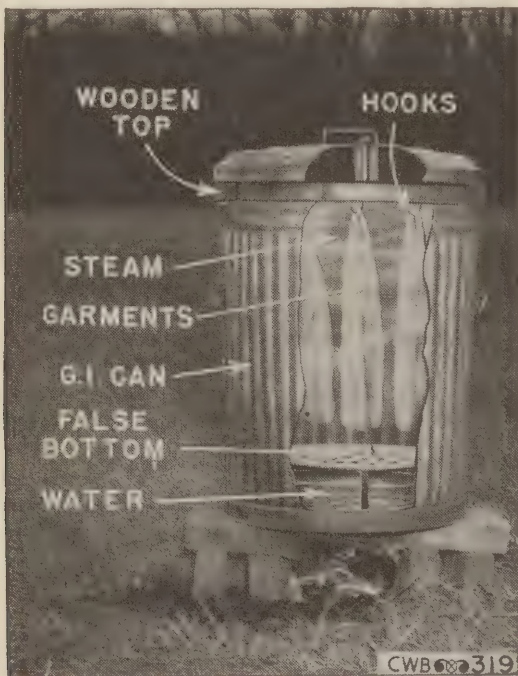


FIGURE 100.—Improvised steaming apparatus.

CHAPTER 6

DECONTAMINATION

	Paragraphs
SECTION I. Prevention of contamination.....	126-131
II. Chemicals and substances.....	132-135
III. Equipment.....	136-139
IV. Methods.....	140-147

■ 126. PERSONAL PROTECTIVE MEASURES.—*a. Protective ointments.*—Protective ointments, when rubbed into the skin, will serve as a protective coating and neutralize vesicant vapor or small drops of the liquid. Ointment may also be used advantageously after exposure to vesicants if it is rubbed well into the contaminated skin areas as soon as possible and before reddening appears.

b. Removal of contaminated garments.—If one suspects his untreated garments have been contaminated, he should immediately remove them and take a thorough soap bath. If a bath is impossible he should follow the first-aid directions set forth in paragraph 9i(3). Serious burns may result if garments contaminated with mustard gas are worn for even a few minutes. (See par. 9f(5).) Even if liquid mustard gas does not soak through to the skin, the person contaminated will receive vapor burns from it. Should there be a spot of liquid clearly visible upon the clothing, and removing the garment is not feasible, the contaminated portion should be cut from the uniform and first aid applied to the body area beneath.

c. Bathing and cleanliness.—Troops who find themselves in a contaminated area, or who are required to traverse such an area, should bathe as soon as the tactical situation permits. Special care should be taken to wash between the toes, in the crotch, and in the armpits. Even if one has not, to his knowledge, been exposed to mustard gas, cleanliness is much to be desired. Bathing will remove accumulations of perspiration and grease which might serve as ideal receivers for subsequent exposures to mustard vapor.

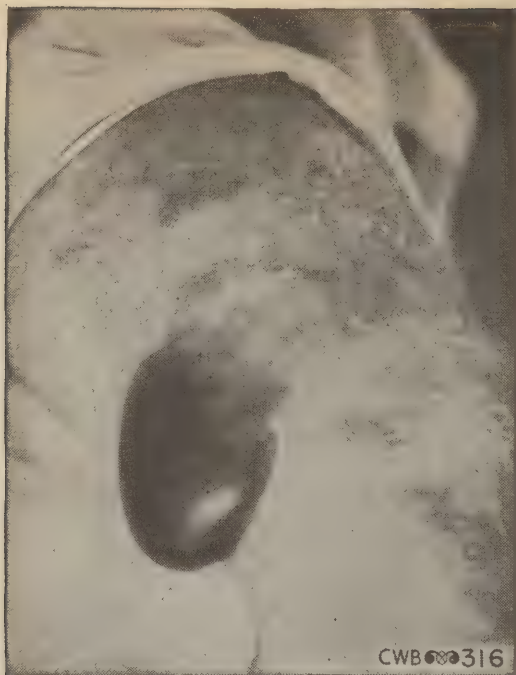


FIGURE 101.—Blister from mustard gas.

■ 127. DETECTION DEVICES.—Since mustard gas and lewisite may be made practically odorless, detection devices are necessary for warning against these agents. For this purpose, a special paint and a special detector paper are provided. With either of them it is possible to detect the presence of liquid vesicants. They are described below.

a. Paint, liquid vesicant detector, M5.—This paint is to be applied by brush or spray to such surfaces as are suitable for painting, such as fences, lamp posts, or other material readily visible in areas where vesicants might be used, in order to render them sensitive to liquid vesicant spray. The paint is olive green in color. On contact with liquid vesicants it

turns red. It is a detector for spray or droplets only, and not for vapor. Drops or splashes of vesicants will turn the paint red wherever they strike.

b. *Paper, liquid vesicant detector, M6.*—This item consists of a fairly heavy sheet of nonabsorptive paper coated with the gas detector paint. It may be used to detect liquid vesicants in—

(1) *Spray form.*—For this purpose the papers are placed, coated side up, in areas where vesicant spray may be anticipated. Droplets of spray falling on the green surface of the paper will develop red spots. Vapors will not cause a color change.

(2) *Ground contamination (liquid vesicants).*—Detector paper may be used to test for liquid vesicants after an area has been contaminated. It is brought in contact with suspected liquid, and if it turns red, a vesicant is indicated. This paper is sensitive only to liquid vesicants and will only detect their presence when surfaces tested are wet. It should not be relied upon to test materials which may have absorbed a vesicant to the point where only vapors are accessible.

■ 128. PROTECTIVE COVERS.—Tarpaulins are used to cover equipment and supplies, and to prevent contamination from airplane spray. When these have once been contaminated they should be decontaminated as soon as possible (see par. 147). They should always be in position whenever practicable, and at other times held in a state of readiness for the immediate protection of matériel. They should fold and be adaptable to quick spreading in case of an attack.

■ 129. PROTECTION OF FOOD.—a. *At the front.*—(1) Bulk items of food, such as coffee, sugar, flour, and bread, issued to troops in the theater of operations, should, so far as practicable, be kept in moisture-resistant containers protected by tarpaulins or similar material until required for actual use.

(2) Cooked rations sent to troops should be kept in closely covered containers until issued. Kitchens should be covered with tarpaulins for protection against chemical spray. Tent flies or other overhead covers should always be provided for field kitchens. If canned goods become sprayed, the cans

should be boiled and then washed in clean, warm water before they are opened.

(3) Food and water contaminated by chemical agents are normally discarded. In case of a shortage of food, special instructions from a medical officer will govern its decontamination.

b. In rear areas.—Whenever practicable, gasproof shelters should be used for storage of food and water supplies.

■ 130. WATER TREATMENT.—Water supply must be protected against contamination by guarding it from its origin to its final destination. Closed containers should always be used. If there is doubt concerning the possible contamination of the water supply, samples must be furnished the Medical Corps for analysis. The Medical Corps will report upon the potability of the water. Should it be contaminated, the Corps of Engineers will supervise the purification processes.

a. Water may be considered safe for consumption provided—

(1) There is no excessive cloudiness or discoloration present.

(2) There is no odor of any chemical agent present in the water before chlorination.

(3) The addition of not more than five parts per million of chlorine (2 ampules of calcium hypochlorite per Lister bag) produces a chlorine residual of one part per million or more.

(4) The pH (acidity) of the water before chlorination is above 5.0.

b. Water that is potentially contaminated with harmful chemicals and has abnormal taste, odors, and other indications of such contamination as brought out by the tests in *a* above, must be given special treatment before it can be used for drinking purposes. Such treatment should be performed only by water supply personnel of the division engineer regiment or battalion or by the engineer water supply battalion.

c. Nothing in this paragraph shall be construed as removing the requirement that all water will be chlorinated to make it potable so far as bacteria are concerned, before being consumed by troops.

■ 131. TREATMENT OF EQUIPMENT.—*a. Ammunition.*—Since brass shell and cartridge cases are particularly susceptible to corrosion by gases such as phosgene, ammunition of this type should be kept in its container as long as practicable. If ammunition becomes badly corroded it may be necessary to discard it (see par. 146). Protection can be provided much more easily than cleaning and decontaminating thousands of shells.

b. Instruments.—Instruments such as those used in fire control should be kept in their containers except when in actual use. If exposed to corrosive gases they should be cleaned with alcohol (or gasoline if alcohol is not available) at the earliest opportunity, after which their moving parts should be given a thin coating of light machine oil.

c. Airplanes.—Where it is not feasible to place airplanes in hangars, they should be provided with gasproof covers, at least for cockpits and guns. Vesicants sprayed upon wings and the fuselage of an airplane may do little if any harm, but if seats, instrument board, control and firing apparatus are sprayed, pilots and observers may later become casualties. Moreover, the decontamination of such parts will be extremely difficult. If an airplane is contaminated with a vesicant agent, vital parts of the airplane should be decontaminated by use of the 1½-quart or 3-gallon decontaminating apparatus to prevent contaminated air from the slipstream finding its way into the cockpit and thus causing casualties.

d. Automotive equipment.—Woods free of underbrush furnish the best protection against chemical attack by either hostile aviation or artillery. The lower portions of ravines and canyons should be avoided for bivouac or assembly areas. (See par. 15.) Full use of the mobility of these vehicles should be made for tactical protection.

e. Flammable supplies.—Supplies such as fuel, oil, and flammable munitions should be kept in containers until actually used. These containers should be such that they may be quickly and effectively cleaned in case of an attack with chemicals. Metal containers may be covered with a thin film of oil as further protection.

SECTION II

CHEMICALS AND SUBSTANCES

■ 132. FOR MUSTARD GAS.—If liquid mustard gas is destroyed, the threat of both liquid and vapor is removed. The chemicals used to destroy mustard should react with the liquid and form a harmless product. Intimate contact between the liquid mustard gas and the destroying agent is necessary to produce efficient and rapid decontamination.

a. Water.—Mustard gas is very slowly hydrolyzed by water, and the reaction product is nonvesicant. The action of cold water upon mustard gas is so slow that it is practically negligible for decontaminating purposes. Hot water is more effective. However, where there is sufficient drainage, mustard gas will be washed away by water. Since it is heavier than water, it will lie at the bottom of pools and puddles, remaining active for a long period of time, though the water over it will retard the escape of gas vapor.

• *b. Chlorinated lime (bleaching powder).*—(1) This material is a white powder. It is not very stable, readily giving up its chlorine when exposed to the air or moisture. Consequently, it should be kept in airtight containers and used as soon as possible after removal therefrom. It is used in bleaching, hence its name. It is also called chloride of lime. Chlorinated lime reacts quickly with mustard gas, forming a nonvesicant compound. In direct contact with liquid mustard, it reacts violently, not only causing flame but driving off a high concentration of mustard gas vapor. If the chlorinated lime is mixed with sand or earth this violent reaction does not occur. A more powerful chlorinating agent is high test hypochlorite or H.T.H. Its percentage of available chlorine is 70 percent as contrasted to an average 35 percent for chlorinated lime.

(2) An alternate method of using chlorinated lime is to mix it with water to form a slurry. This is a 50-50 mixture by weight of bleaching powder and water. It is spread over the surface to be decontaminated and left for 24 hours if possible. The 50-50 slurry mixture provides the best sticking qualities to chloride of lime. As mustard gas vapors emerge

from walls, ceilings, or ground, they are immediately neutralized by the chloride of lime that has adhered to this surface.

c. Decontaminating agent, noncorrosive.—An additional material known as agent, decontaminating, noncorrosive, is prepared by dissolving one pound of solid noncorrosive agent (RH-195 or CC No. 1) in 15 pounds of solvent (acetylene tetrachloride) by weight, or one part of agent to 6¼ parts of solvent by volume. This decontaminating agent is much less injurious to matériel than any of the others mentioned. It is suitable for use on leather, cotton fabrics, instruments, and other items that might be damaged by the corrosive action of bleaching powder or other chemically active decontaminating materials.

d. Miscellaneous chemicals.—A number of chemical substances have a neutralizing effect upon mustard gas. Their use, however, is limited, and they are but briefly mentioned here.

(1) *Sodium sulfide.*—Sodium sulfide used as one percent aqueous solution reacts slowly. About 6 gallons of solution are needed per square yard of area to be decontaminated.

(2) *Sodium bicarbonate.*—When mixed with commercial hypochlorite solution in the ratio of 1 pound per gallon of solution, the result is called "green solution" because of its slightly green color. It is less corrosive than bleaching powder, but is also less efficient.

(3) *Neutralizing agents.*—Alkalies such as caustic soda, washing soda, or soap increase hydrolysis and hasten the neutralization of mustard gas by the action of water.

■ 133. FOR LEWISITE AND OTHER ARSENICALS.—Decontamination for lewisite essentially parallels that for mustard gas except that it is readily decomposed by water, and therefore liberal wetting of areas so contaminated is sufficient to destroy this agent. The reaction product, however, is a vesicant solid that will cause severe burns upon contact with the body. Consequently, even long after decontamination of a lewisite area with water, it is dangerous to sit or lie down in the area. After treatment with water, a lewisite area should, if practicable, be covered with a layer of earth, sand, or ashes.

■ 134. FOR CHLORPICRIN.—Chlorpicrin is a very stable compound, and its persistency under average conditions is about 3 hours. To neutralize liquid chlorpicrin, a hot solution of sodium sulfide is used.

■ 135. FOR TEAR GAS.—To remove solid chloracetophenone a hot solution of sodium carbonate (washing soda) can be used.

SECTION III

EQUIPMENT

■ 136. DECONTAMINATING APPARATUS, 1½-QUART.—This apparatus is of the self-contained, hand-operated, fire-extinguisher type, and has a net capacity of 1½ quarts of liquid (fig. 102). It is carried as essential equipment in each truck and airplane, and is used in decontaminating small arms or items of equipment. Only true solutions should be used in this apparatus, as suspensions containing solid particles may clog the mechanism. The noncorrosive decontaminating agent is the only approved filling (see par. 132c). If the solution remains in the container for as long as 3 months, the container should be drained, thoroughly cleaned, and filled with new solution. The 1½-quart apparatus is used for prompt decontamination of small but important items or surfaces.

■ 137. DECONTAMINATING APPARATUS, 3-GALLON.—The 3-gallon pressure type apparatus is designed for spraying contaminated equipment with the solution of noncorrosive decontaminating agent. However, a strained suspension of chlorinated lime in the form of slurry may be used for the decontamination of buildings or equipment which will not be affected seriously by the agent. The slurry is made by mixing three shovelfuls of chlorinated lime with sufficient water to make 3 gallons. Stir thoroughly and then strain before placing in the apparatus. The apparatus is a modified insecticide sprayer, equipped with an air pump and a discharge hose with valve and nozzle (fig. 103). Air is compressed over the liquid, forcing it through the hose and nozzle. To operate, the top is closed and locked and the pump operated 30 to 40 strokes. The apparatus is then slung upon the shoulder,



FIGURE 102.—One and one-half-quart apparatus.

the valve lever pressed, and the area sprayed. Additional air is pumped into the tank as needed to maintain the required pressure. After using slurry, the container is thoroughly rinsed with water and considerable water forced through the discharge line and nozzle. It is best used when decontaminating matériel rather than contaminated terrain.



FIGURE 103.—Three-gallon apparatus.

■ 138. POWER-DRIVEN DECONTAMINATING APPARATUS.—*a. General.*—The 1½-quart and the 3-gallon apparatus are widely distributed among troop organizations. The 400-gallon power-driven apparatus is assigned only to special decontaminating personnel. This is designed for large scale operations, such as airplane runways, roads, and buildings. Mounted upon a 2½-ton truck equipped with a power take-off (fig. 104), it is a modified insecticide sprayer with agitator and power-driven pump capable of delivering approximately 30 gallons per minute at a working pressure of 400 pounds per square inch.

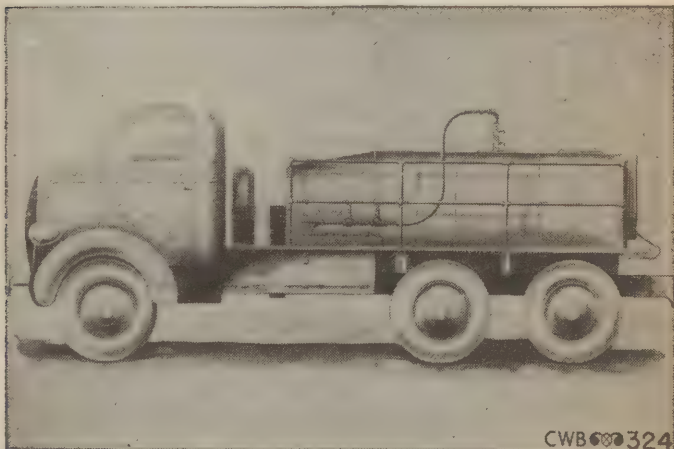


FIGURE 104.—Four hundred-gallon apparatus.

b. Charging.—Equal weights of chlorinated lime and water are agitated in the tank from 5 to 20 minutes, depending upon the charge. A full charge is 2,080 pounds of chloride of lime and 260 gallons of water, and requires from 45 to 60 minutes to load and mix. Men should wear masks when emptying containers of bleaching powder.

c. Application.—One or both nozzles are operated by men seated upon the front fenders. The truck advances slowly as the area is covered.

d. Cleaning.—To clean the apparatus the tank is first drained and flushed with 60 to 70 gallons of clean water

through the nozzles, after which the screens are removed and cleaned. Nozzle guns are removed from the hose, dismantled, and immersed in lubricating oil. The bleach intake valve is next removed and the chlorinated lime scraped off, the valve being removed and immersed in lubricating oil. The entire machine is now hosed down with water, and a 50-50 mixture of oil and water drawn in through the intake valve and flushed through the pump and out through the hose.

■ 139. BATHING UNITS.—The installation and operation of bathing units is a function of the Corps of Engineers. However, the water in these units may not always be sufficiently warm for use by men who have become contaminated with chemical agents. Accordingly, means and methods in the field must be improvised for furnishing men with warm water. (See par. 116b.)

SECTION IV

METHODS

■ 140. EARTH AND SHELL CRATERS.—*a. Determining need of decontamination.*—Before considering decontamination of any area, such as one produced by a chemical shell, the first decision is whether the area can be avoided. If that is not practicable, then plans must be made to conduct the minimum amount of decontamination.

b. Contaminated area.—When a chemical shell explodes, a comparatively shallow crater is produced. However, if the shell contains a vesicant the crater and the ground immediately adjacent to it may be liberally splashed with liquid agent. The larger the shell the greater the area heavily contaminated (see par. 21).

Chemical shell (liquid)	Burst-average diameter (yds.)	Area contaminated (sq. yds.)
75-mm.....	8	25
105-mm.....	10	70
4.2 inch.....	12	113
155-mm.....	15	177

c. *Procedure.*—(1) *Covering.*—Although not strictly a method of decontamination, the crater and the surrounding ground may be covered with earth to a depth of 3 to 4 inches. This will give temporary protection.

(2) *Earth-bleach method.*—With earth-bleach decontamination, all grass on the area is first cut. The detail, working up wind, obtains a supply of loose earth. This is then intimately mixed with dry chlorinated lime in the proportion of two shovelfuls of chlorinated lime to three shovelfuls of earth. The mixture is applied from the up wind side in such a way that the decontaminating detail walks on freshly covered areas and not on contaminated ground. One pound of chlorinated lime is used per square yard for average contamination. Larger amounts of the earth-bleach mixture are applied to the more heavily contaminated portions. After the mixture is applied, it is thoroughly raked. Greater protection is obtained if a layer of earth is spread over the mixture. If concealment from aerial observation is desired, the area may be camouflaged with brush and grass. The earth-bleach method is extremely arduous and tiring. The amount of chlorinated lime needed is often excessive, and its use should be recommended only if other methods are impracticable. The earth-bleach method is the least practicable of decontamination procedures because of its excessive labor requirements.

(3) *Direct method.*—Under certain circumstances it may be feasible and practicable to use the raw chlorinated lime directly in contact with the contaminated area instead of the earth-bleach method of decontamination. This may be done when personnel will not be endangered by the vapors released, when the danger of fire need not be considered, or when there is not a large quantity of liquid mustard gas present. Personnel should be equipped with protective clothing and work up wind of the contaminated area. Chlorinated lime should be applied to the outer edges of the area with long-handle shovels, then progressively toward the center. When chlorinated lime is used in this manner, decontamination is accomplished in a much shorter time than with the earth-bleach method. If desired, terrain thus decontaminated may be covered with grass or other camouflaging material.

■ 141. GRASS AND LOW VEGETATION.—*a. Determining the area of contamination.*—If the contamination is very recent, droplets of the vesicant will be visible on the vegetation. If the area has been contaminated for several hours the vegetation will have become dehydrated and appear parched, and the extent of contamination will be easily determined. Personnel making the reconnaissance should be equipped with protective clothing and masks. Before deciding to decontaminate the area a search should be conducted for alternate routes around it. A decision to decontaminate should be made only as a last resort.

b. Procedure.—(1) *Incineration.*—If the area contaminated is covered with grass or short undergrowth the quickest and most efficient method of decontamination is by burning. If the grass is dehydrated or dry, no special measures will be necessary to make it burn. It is simply ignited on the up wind side. If precautions are necessary to prevent the spread of the blaze, all personnel should be in protective clothing and masks, and be equipped with the necessary tools to extinguish the fire should it spread. An area slightly in excess of that contaminated is usually burned. Since heat generated by the burning vegetation is sufficient to vaporize the majority of the vesicant, care should be taken to have any personnel down wind either in protective clothing and masks, or vacated from the vicinity. If vegetation is green or wet, it may be necessary to use a flame thrower or spread fuel oil over the area before igniting it.

(2) *Earth-bleach method.*—All brush, weeds, and tall grass must be cut down and removed by personnel in protective clothing. The desired area is then covered with the earth-bleach mixture as described in paragraph 140c(2).

(3) *Protective mats.*—Although not a method of decontamination, a protective mat furnishes a satisfactory means of making a path through a contaminated area. The procedure is simple. A roll of rubberized or asphalt roofing material is unrolled over the desired area from which brush and tall weeds have been removed. The troops mask and pass quickly over this improvised mat in comparative safety. The mat is not used again. If desired, it may be rolled up and buried or destroyed by personnel in protective clothing.

(4) *Chlorinated lime spray.*—Grass may be covered with a chlorinated lime spray from a 400-gallon power sprayer. However, an hour should elapse before troops are permitted to pass over the area in order to allow time for the chlorinated lime to act. White areas that result are easily spotted from the air and may furnish an ideal target for future bombardment.

■ 142. WOODS AND HIGH VEGETATION.—*a.* When reconnaissance shows that it is impossible to detour an area of woods and high vegetation because the entire area is contaminated, then decontamination must be employed. To traverse a contaminated area covered with high vegetation it is necessary to cut a path through it. The cutting detail is equipped with protective clothing and masks.

b. If the area to be traversed is heavily wooded, the detail should merely cut low branches and brush to form a pathway. Paths may then be prepared by the earth-bleach method or by the use of protective mats. The ideal way is to spread fuel oil on the path and, by burning, decontaminate it in that fashion. But this method can be used only when the fire hazard is limited. If the contamination is by spray from an airplane, troops can probably pass safely through the path without having it decontaminated, as a large proportion of the agent will have collected in the upper foliage of the trees.

■ 143. STREETS AND HIGHWAYS.—*a. Paved roads.*—When it becomes necessary to decontaminate paved roads the following methods may be employed:

(1) Flush with water if well drained and a sufficient water supply is available.

(2) Spray with chlorinated lime suspension from the 400-gallon power-driven apparatus and recamouflage.

(3) Spray with a light fuel oil and ignite if the danger of fire and from vapor is not too great.

(4) Scrub with chlorinated lime slurry (fig. 105). Recamouflage if necessary.

(5) If no other means are available, a small area may be traversed temporarily if it is first covered with two to four inches of earth.



FIGURE 105.—Scrubbing pavement with slurry.

b. Dirt roads.—Methods described in (2), (3), and (5) above are also applicable for dirt roads. Dirt roads may also be decontaminated with a mixture of earth and bleach as described in paragraph 140c(2).

■ **144. BUILDINGS AND STRUCTURES.**—**a. General.**—Decontamination of the exterior surfaces of a building is usually practicable, but if the inside is grossly contaminated, the process will be extremely difficult. Interiors contaminated by vapor only can be cleared by thorough ventilation.

b. Wooden structures.—Liquid vesicants quickly and deeply penetrate wood and, although the agent is removed from the surface, the hidden agent will gradually volatilize and escape into the room. Paint offers little resistance.

(1) To treat such contaminated surfaces a chlorinated lime slurry is applied with brushes, swabs, or the 3-gallon hand pressure apparatus. The area is washed with soap and water after 24 hours.

(2) In the event of contaminated floors, slurry is brushed into all cracks and allowed to remain from 6 to 24 hours.

(3) On the outside of the building either the 400-gallon power sprayer (fig. 106) or the 3-gallon hand apparatus may be used to coat the contaminated parts with a chlorinated lime slurry. The area is washed after 24 hours and recamouflaged if necessary.



FIGURE 106.—Four hundred-gallon apparatus in action.

(4) If possible to vacate the premises, weathering for 1 to 2 weeks will cleanse the building. In hot weather a much shorter time is needed.

c. Brick, stone, and concrete structures.—(1) Smooth surfaces do not absorb as much agent as rough material. In any case, however, chlorinated lime slurry should be applied and allowed to remain from 6 to 24 hours, depending upon the degree of contamination.

(2) If practicable, the outside may be washed with water. This water will carry a heavy concentration of agent down to the ground where it may be neutralized by chloride of lime.

■ 145. DEBRIS AND RUBBISH.—Whenever debris or rubbish is contaminated it should be burned so far as possible, and if not possible, it should be buried. Debris contaminated with mustard gas is difficult to decontaminate. Where the mustard gas vapor from a pile of debris is carried by the wind over important installations, the vapor can be held to a minimum by wetting down the debris pile with a hose. However, this will carry the mustard farther into crevices and underneath where it will possibly take longer to decontaminate by aeration or weather.

■ 146. EQUIPMENT.—*a. Ammunition.*—In the case of ammunition corroded by phosgene, the shells should immediately be cleaned and coated with a light oil. If heavily corroded it may be necessary to discard them. If contaminated with a vesicant, the shells may be wiped off with rags soaked in kerosene or noncorrosive decontaminating agent. Care should be taken to burn or bury the rags used in the wiping process, and personnel performing these operations should wear protective clothing.

b. Weapons and metal equipment.—Greasy or oily metal surfaces contaminated with vesicant liquid should first be cleaned with kerosene or gasoline. These solvents do not destroy the vesicant, but dissolve it so that most of it may be removed. Rags used for the purpose should be burned in a fire with a good draft or buried, as they will be grossly contaminated. After such treatment a very thin coating of agent will remain on the surface of the metal that still will be dangerous to touch. This residue is difficult to remove and must be treated with neutralizing chemicals. The best way to remove it is to spray a solution of the noncorrosive decontaminating agent upon the surface. When this has dried, the residue is washed off with soap and water, the surface wiped dry, and a thin layer of oil applied. For alternate methods see c(2) below.

c. Airplanes.—(1) The method of decontaminating airplanes is the same as with weapons and metal equipment (fig. 107). (See *b* above.) Care should be taken to prevent the noncorrosive decontaminating solution from remaining for any length of time in contact with rubber parts of the airplane as it has a softening effect upon the rubber. The

plastic windows usually placed over the cockpit should be thoroughly washed with kerosene and *not* with noncorrosive decontaminating solution.



FIGURE 107.—Decontaminating an airplane.

(2) Alternate methods consist of the use of slurry, hot sodium sulfide, or green solution, the latter two being much less corrosive than the slurry. To avoid serious corrosion through the use of slurry, the application should not be left on for more than an hour at most. The surface should then be washed, dried, and oiled. However, the noncorrosive decontaminating agent is the most effective for use on weapons and metal equipment. When it is not necessary to use the equipment immediately, 6 to 8 days' aeration will vaporize the agent, after which the matériel may be safely handled.

d. Automotive equipment.—Tanks and motor vehicles contaminated by persistent chemical agents should be decontaminated at first, second, third, and fourth echelons along parallel lines with echelon maintenance described below. They should be moved out of the contaminated area and isolated in a place free of brush and vegetation.

(1) *First echelon decontamination.*—Vehicles lightly contaminated should be decontaminated as soon as the tactical situation permits, employing gasoline or Diesel oil and waste, followed by use of the 1½-quart decontaminating apparatus. (See par. 136.) The first man to dismount from the vehicle should, while dismounting, decontaminate such parts of the vehicle as may become necessary to prevent injury to himself and those following him in dismounting. Should the vehicle also require first echelon maintenance, the necessary decontamination should be conducted to permit the performance of such work without injury to personnel.

(2) *Second echelon decontamination.*—Vehicles contaminated to such an extent that the means provided in the first echelon are inadequate should be decontaminated at the second echelon by use of the 3-gallon hand apparatus, or have this apparatus brought forward to the vehicles. (See par. 137.) Due to the resultant white stain left upon metal surfaces when the chlorinated lime slurry has been used, and the time involved in its neutralization of the chemical agent, this mixture frequently can be employed only upon the under surface of the vehicle. In such case the noncorrosive decontaminating solution should be used upon the other metal surfaces. If second echelon maintenance work is also required, the necessary decontamination of equipment should be conducted first to prevent injury to personnel.

(3) *Third echelon decontamination.*—Contaminated vehicles which require such servicing and repairs as are normally performed at third echelon maintenance should be given third echelon decontamination prior to servicing and repair. At this installation thorough decontamination of the entire vehicle is performed. It involves the following steps:

(a) Thorough washing to remove all caked mud or dirt, employing water under necessary high pressure such as produced by the 400-gallon decontaminating apparatus. (See par. 138.)

(b) Steam cleaning, for removal of all surface grease, a steam jenny or similar apparatus being used. (See fig. 108.)

(c) Application of the appropriate decontaminating agent to the various types of material in the vehicle, and coating finished surfaces with a light film of oil.



FIGURE 108.—Steam jenny in action.

(4) *Fourth echelon decontamination.*—When contaminated vehicles are received at fourth echelon for repairs or overhaul, they should first be decontaminated as prescribed above under third echelon decontamination.

■ 147. MATERIALS.—*a. Metal and glass.*—Smooth surfaces such as metal and glass are very easily decontaminated because there is no penetration of the agent.

(1) *Weathering.*—If a metal roof is contaminated, weathering will take care of the agent, especially if it is warm, thus increasing the vaporization.

(2) *Flushing with water.*—A heavily contaminated metal surface should be thoroughly flushed with water, care being taken to provide adequate drainage.

(3) *Slurry.*—A slurry may be placed on a metal surface if there is no objection to a moderate amount of corrosion. It may also be used on glass surfaces. This decontaminating agent should be flushed off metal after 1 hour.

(4) *Agent, decontaminating, noncorrosive.*—If the metal would be harmed by corrosion, a solution of the noncorrosive decontaminating agent may be used as specified in paragraph 146b. A solution of noncorrosive decontaminating agent may also be used safely on glass surfaces.

b. Cloth and fabric.—Fabrics contaminated only by vesicant vapor are decontaminated by exposing them to sun and air for a period of 2 days in bright weather. If the weather is unfavorable, or if the contamination is heavy, steaming should be employed. (See par. 125.) Covers contaminated with liquid vesicants may be treated with the noncorrosive decontaminating solution. (See par. 132c.)

c. Rubber and leather.—Rubber and leather are penetrated by vesicants. They should be treated with a hot suspension of chlorinated lime immediately after being contaminated. Under no circumstances should noncorrosive decontaminating solution remain in contact with rubber as softening and swelling results. Shoes worn in contaminated areas should be frequently shuffled in an earth-bleach mixture as a precautionary measure. Gas masks should be scrubbed immediately with hot slurry. Precautions should be taken to prevent decontaminating materials from entering the facepiece, canister, or eyepieces. Soap and water are used to wash the eyepieces and to remove the slurry from the facepiece, after which the mask is thoroughly rinsed in warm water. If leather is heavily contaminated and has not been immediately treated, it should be discarded, as decontamination is impossible. If lightly contaminated, it may be treated with noncorrosive decontaminating solution.

CHAPTER 7

MILITARY ANIMALS IN CHEMICAL WARFARE

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SECTION I

SENSITIVITY OF THE HORSE TO CHEMICAL AGENTS

■ 148. GENERAL.—*a.* The physiological effects of most chemical warfare agents on horses and men are similar, but the problem of providing protection against vesicant agents differs considerably. The soldier engaged in combat is more or less fixed to a locality and, when under fire, probably is in close contact with the ground, even lying in fox holes. His protective equipment must therefore provide protection against inhalation of vapors as well as prevent body contact with liquid vesicants. In sudden attacks or under certain tactical conditions, animals may be contaminated with liquid vesicants, in which case skin injury will result, especially in instances where there is contamination of the lower leg. When only vesicant vapors are encountered horses may receive considerable exposure without developing incapacitating injuries, especially when protected by the gas mask.

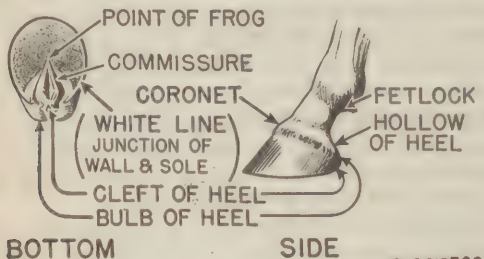
b. For purposes of chemical defense and for protection of riding and draft animals, horses and mules are enough alike in anatomy and sensitivity to chemical agents to be considered as one. Protection for them depends somewhat upon a knowledge of the important parts of their anatomy and body functions. The parts of the horse primarily affected by chemical agents are the respiratory system, skin, feet, eyes, and digestive tract.

■ **149. FIRST-AID MEASURES.**—In the event of a chemical attack, all horses must be masked immediately and provided with any other sort of protection available, such as cover. Vesicants on the hair should be removed as soon as possible. When animals are burned by particles of phosphorus, the first effort should be to exclude air from the affected part. A temporary measure is the application of water until the particles can be removed.

■ **150. RESPIRATORY SYSTEM.**—In general, the air passages and the lungs are sensitive to the action of chemical agents of the lung irritant and vesicant type.

■ **151. EYES.**—The eyes of horses are not seriously affected by lacrimators, and it is therefore not essential that protection be provided, but they are sensitive to vapors of vesicant agents. Liquid vesicants in the eyes will cause serious injury and may destroy the sight.

■ **152. SKIN AND HOOF.**—*a. How affected.*—While liquid vesicant agents will injure any part of the skin, the greatest incapacitation results from their action on the hoof and lower leg (fig. 109). Burns from vesicants on other parts of the skin, while annoying and painful, usually do not totally incapaci-



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FIGURE 109.—Vital parts of horse's hoof.

tate horses for work. The horn of the hoof, including the frog, is sufficiently resistant to protect the sensitive hoof, whereas the coronet, the fine skin of the bulb of the heel, the fetlock, and particularly the hollow of the heel are sensitive and incapacitating when affected. Other parts of the skin

devoid of hair where sweat glands are most active are quite sensitive to vapors as well as liquid vesicants. By an air buffer effect, a full natural coat of hair tends to hold up penetration of liquid mustard gas by increasing lateral spread of droplets.

b. Protective leggings.—Protective leggings covering the sensitive parts of the hoof and lower leg will permit horses to traverse recently contaminated areas. The effect of moving animals through an area recently contaminated, where liquid droplets may be seen upon foliage, will result in severe injury and incapacitation with 24 to 48 hours. A like movement through contaminated areas which have been exposed to the direct action of the sun and wind for several hours may result in only minor burns. The relatively safe length of time of such exposure to sun and wind will depend upon the degree of contamination, the physical properties of the contaminating agent, and upon atmospheric conditions.

■ 153. DIGESTIVE TRACT.—When contaminated forage is eaten or contaminated water drunk, casualties will result. In the case of contamination with vesicant agents, animals may be affected with an inflammation and ulceration of the entire digestive tract. Forage and water exposed to nonpersistent agents such as phosgene or chlorine produce no specific problem.

■ 154. EFFECT OF LUNG IRRITANTS.—*a. Symptoms.*—For lung irritants the symptoms and effects are as follows:

(1) *Immediate.*—Warning to attendant is by typical odor or the coughing of the horse when in contact with high concentrations.

(2) *Delayed.*—Several hours after exposure to light concentrations the animal may have the appearance of suffering, with nostrils dilated, eyes staring, and breathing labored. Recovery will usually occur in about 5 days. In animals exposed to heavy concentrations the breathing is hurried and noisy, and the nostrils dilated and exuding a foamy to thick bloody discharge. The animal may die in 4 to 48 hours.

b. Protection.—(1) *Individual.*—The horse mask is adjusted upon detecting gas.

(2) *Collective.*—Stable windows and doors are covered with blankets, and holes and cracks stuffed with wet hay, newspapers, or mud.

■ 155. FIRST AID FOR LUNG IRRITANTS.—*a.* Adjust the mask on the horse.

b. Remove the animal from the gassed area, if possible, with the least physical effort on the part of the horse.

c. Keep the animal quiet and warm. All affected animals should be placed in the care of a veterinary.

■ 156. EFFECT OF VESICANTS.—*a. Symptoms.*—For vesicants the symptoms and effects are as follows:

(1) *Respiratory effects.*—Vapor causes delayed inflammation and destruction of the lining of the nose and of membranes of the respiratory tract. Pneumonia usually follows.

(2) *Skin.*—(*a*) Vapor affects bare skin, especially where profuse sweating occurs.

(*b*) Liquid droplets cause a raising of the hair within 15 minutes, followed by wrinkling and deadening of the affected skin. Later such places may develop into ulcers and deep sores.

(3) *Eyes.*—(*a*) Vapors cause swelling and a discharge from the eyes.

(*b*) Liquid injures the eyes. The horse will rub its eyes and show evidence of pain and itching within a few minutes. Blindness may result.

(4) *Lower leg and hoof.*—Liquid or liquid contaminated earth in contact with the vulnerable parts of the leg may result in lameness and permanent injury to the animal.

(5) *Digestive tract.*—Contaminated food or forage will cause inflammation and ulcers in the digestive tract followed by loss of appetite, weakness, and bloody diarrhea. If the injury is due to M1, the horse will suffer from systemic arsenical poisoning.

b. Protection.—(1) *Individual.*—Adjust the horse mask for protection of the lungs, and hoodwink the eyes to protect from spray. The body should also be covered with a blanket in anticipation of airplane attack.

(2) *Collective.*—Buildings in which animals are sheltered should have holes and cracks sealed. Mud and grass may be used as sealing materials to eliminate drafts and prevent inflow of gas. The location of open shelters and picket lines in small valleys and ravines where high gas concentrations

are likely to occur, or near strategic points which are likely targets for gas attack, should be avoided. Animals should be restrained from grazing, or drinking water from water holes trenches, or shell craters in areas that recently have been contaminated. Water in large running streams, deep wells, or large lakes can usually be regarded as nontoxic. When no other source of supply is available, water from small streams or holes known to be contaminated only with HS may, with extreme care, be used, provided there is no visible agent on the surface. Water should be drawn from a point below the surface and well above the bottom. Care should be taken that none of the agent on the bottom is disturbed. Forage contaminated with *liquid* HS or M1 should be destroyed. However, in most cases of vapor contamination, forage may be fit for consumption following a complete airing, preferably in the sun. This procedure will be satisfactory for vapor contamination by all nonpersistent agents. Forage is best protected by impervious coverings or by storage in airtight shelters when in areas likely to be contaminated by gas.

■ 157. FIRST AID FOR VESICANTS.—*a.* Attendants must wear protective gloves and, if available, protective clothing when handling animals injured by vesicants.

b. For lung injuries, first aid is the same as for lung irritant cases.

c. For vapor contact with the skin of animals, where the exposure has been heavy or of long duration, it may decrease the severity of the injury to wash the animal within 15 minutes either with soap and water or with water alone. Swimming in a nearby stream might be useful when other means for washing are not available.

d. For liquid contact with the skin the severity of an injury may be appreciably reduced if treatment begins within 10 or 15 minutes after exposure. The area should be bathed with a solvent such as gasoline or kerosene, remembering that this dissolves and dilutes but does not neutralize the agent. Washing with soap and water should follow. When it is known that the agent is mustard gas, a slurry may be applied and then washed off completely in 5 minutes. When no water is available, and the contamination is known to have been by

HS, application of protective ointment will diminish the extent of the injury. Particular attention in first-aid treatment should be given the lower legs and hoofs of unprotected horses that have traversed contaminated ground.

e. Horses with eye injuries should be tied short to prevent them from rubbing and further irritating the injury. Continued irrigation of injured eyes with a solution of boric acid or baking soda (1 teaspoonful to 1 pint of water) is beneficial.

f. Horses with large areas of skin swelling or indications of affected lungs should be hospitalized.

THE HORSE IN CHEMICAL WARFARE

Physiological class	Lung irritants (choking)	Vesicants (blistering)
Examples (CW symbols).	Cl-CG-PS	HS-M1-ED
Symptoms and effects.	<p>a. <i>Immediate</i>.—Warning to attendant by typical odor. Coughing of horse when in contact with high concentrations.</p> <p>b. <i>Delayed</i>.—Several hours after exposure to light concentrations animal has appearance of depression, nostrils dilated, eyes staring, breathing labored. Recovers in about 5 days. In animals exposed to heavy concentrations, breathing is hurried and noisy, nostrils dilated with foaming to thick bloody discharge. The animal may die in about 48 hours.</p>	<p>a. <i>Immediate</i>.—Warning to attendants by typical odor.</p> <p>b. <i>Respiratory effects</i>.—Vapor causes inflammation and destruction of lining of nose and of membranes of respiratory tract. Pneumonia often follows.</p> <p>c. <i>Skin</i>.—(1) Vapor affects fine skin, especially where profuse sweating occurs. (2) Liquid droplets cause swelling in 15 minutes followed by wrinkling and deadening of the affected skin. Later such places develop into ulcers and deep sores.</p> <p>d. <i>Eyes</i>.—(1) Vapors cause swelling and a discharge from the eyes. (2) Liquid injures the eyes. Animal will rub eyes and show evidence of pain and itching within a few minutes. Blindness may result.</p>

THE HORSE IN CHEMICAL WARFARE—Continued

Physiological class	Lung irritants (choking)	Vesicants (blistering)
Examples (CW symbols).	Cl-CG-PS	HS-M1-ED
Symptoms and effects—Continued		<p><i>e. Feet.</i>—Liquid or liquid contaminated earth in contact with the vulnerable parts of the foot may result in lameness and permanent injury to the hoof.</p> <p><i>f. Digestive tract.</i>—Contaminated food, forage, or water will cause inflammation and ulcers in the digestive tract followed by loss of appetite, weakness, and bloody diarrhea. If injury is due to M1 or ED, the horse may suffer from systemic arsenical poisoning.</p>
Protection.....	<p><i>a. Individual.</i>—Adjust horse mask on detecting gas.</p> <p><i>b. Collective.</i>—For stables, cover windows and doors with blankets and stop up other holes and cracks with wet hay, newspapers, or mud.</p> <p>For picket lines and in open, avoid areas likely to be gassed.</p>	<p><i>a. Individual.</i>—Adjust horse mask for protection of lungs. Hoodwink eyes to protect from vapor and sprays. Also cover body with a blanket in preparation for airplane spray.</p> <p><i>b. Collective.</i>—For stables, cover doors and windows with blankets and stop up other holes and cracks with wet hay, newspapers, or mud.</p> <p>Avoid locating open shelters and picket lines in gassed areas, or positions likely to be gassed as woods in valleys. Detour around contaminated areas if on the march.</p> <p>Do not permit animals to graze or roll near contaminated shell holes or pastures. Cover forage against airplane spray attacks.</p> <p>Do not water from shell holes or small streams in contaminated areas.</p>

THE HORSE IN CHEMICAL WARFARE—Continued

Physiological class Examples (CW symbols).	Lung irritants (choking) Cl-CG-PS	Vesicants (blistering) HS-MI-ED
First aid.....	<p>Adjust mask on horse.</p> <p>Remove animal from gassed area with the least possible physical effort to the animal.</p> <p>Keep animal quiet and warm.</p> <p>Place affected animals in care of veterinary surgeon.</p>	<p>a. Attendants must wear protective gloves and if available, protective clothing when handling cases of animals injured by vesicants.</p> <p>b. For lung injuries, first aid is the same as for lung irritant cases.</p> <p>c. For vapor contact on the skin of animals, wash with soap and water or water within 15 minutes. Continue washing for 30 minutes.</p> <p>d. For liquid contact on the skin, cover spots or skin areas with bleach paste (two parts water, one part commercial chloride of lime), and remove within 5 minutes. Wash with running water for 30 minutes. If no bleach paste is available, use soap and water or water alone. For best results the treatment must begin early, within 10 to 15 minutes.</p> <p>e. After crossing contaminated ground, the feet should be cleaned and thoroughly washed.</p> <p>f. Horses with eye injuries should be tied short to keep them from rubbing and further irritating the wound. Continued irrigation of injured eyes with a very weak solution of boric acid or baking soda (1 teaspoonful to 1 pint of water) is beneficial.</p> <p>g. Hospitalize horses with large areas of skin swelling or indications of lung effect.</p>

SECTION II

HORSE GAS MASKS M4 AND M5

■ 158. COMPARISON.—Horse gas masks are similar in principle to masks used by men. On each mask a muzzlepiece of molded rubber is shaped to fit the nose and mouth, and provides an airtight seal. A pair of canisters is used, which removes both gas and irritant smokes or smoke particles from the air. The M4 mask has a canister suspended on each shoulder of the horse, while the M5 mask has both canisters suspended on the off (right) shoulder for horses carrying a rifle on the near (left) side of the saddle (fig. 110).



FIGURE 110.—M4 and M5 horse gas masks.

a. Horse gas mask M4.—The M4 mask is designed for use with the McClellan saddle, the officers' field saddle (fig. 111), the Phillips pack saddle (fig. 112), the quartermaster stock saddle, with the various types of draft harness, and with horses equipped only with a halter and surcingle.



FIGURE 111.—M4 horse gas mask.



FIGURE 112.—M4 horse gas mask with Phillips pack saddle.

(1) *Muzzlepiece*.—The muzzlepiece is designed to fit all sizes of horses and mules. The aperture for the muzzle is considerably smaller than the muzzle of the smallest horse, and the gastight seal is obtained through the elasticity of the rubber from which the muzzlepiece is made. An embossed line is molded around the lower edge of the aperture, and the rubber may be cut along this line if it is necessary to adjust the muzzlepiece to fit horses with large muzzles. For horses with extremely large muzzles it may be necessary to enlarge still further the aperture by cutting from $\frac{1}{16}$ to $\frac{1}{8}$ inch strip away all around the existing aperture. Any enlargement of the aperture must be supervised by an officer, and such enlargement resorted to only when absolutely necessary. A better seal is obtained when the aperture is small, although it may be a little more difficult to adjust the muzzlepiece to the horse. The muzzlepiece has an inlet valve as a part of the inlet tube and an outlet valve for exhaled air and drainage (fig. 113). Adjustable leather

straps with harness snaps are attached to the muzzlepiece so that it may be secured to the halter.



FIGURE 113.—Valve action of horse gas mask.

(2) *Harness.*—The harness is of leather, and is adjustable throughout. If necessary the narrow straps may be replaced by the issue coat strap.

(3) *Hose.*—The hose is made of corrugated rubber $\frac{1}{16}$ inch thick and covered with rubberized stockinet.

(4) *Carriers.*—The canister carriers are made of leather, rather than of duck, so that they will not chafe the horse and also be more durable. The side of each carrier next to the horse is flat, to prevent it from rolling and the opposite side round to conform to the shape of the canister. The

muzzlepiece and hose carriers are made of duck but with a leather back to prevent chafing of the horse's breast. The branch hose is secured within the carrier by two web straps.

b. *Horse gas mask M5.*—The M5 mask is designed for use with the McClellan saddle on horses carrying the rifle on the left side (fig. 114). The parts of this mask are identical with those of the M4 except as described below.



FIGURE 114.—M5 gas mask—rifle accommodation.

(1) *Carrier.*—Both canisters are carried in a two cell leather pouch slung on the right side of the horse.

(2) *Canister connector.*—A rubber manifold connects the air outlet of the canisters with the hose leading to the muzzlepiece.

(3) *Hose.*—A single hose made of corrugated rubber covered by rubberized stockinet connects the manifold and the muzzlepiece.

(4) *Muzzlepiece carrier.*—The single hose is secured at a position inside the muzzlepiece carrier by means of the web strap on the right side within the carrier.

■ 159. ADJUSTMENT OF HORSE GAS MASK M4.—*a. Adjustment to the carry position.*—(1) To adjust the mask to the carry position, place the mask on the horse at a point in front of the saddle (fig. 115).

(2) Attach the snaps of the right and left pommel straps from the top rear of the canister carriers to the pommel rings of the saddle (fig. 116).

(3) Attach the strap passing across the neck to the ring on the left canister carrier (fig. 117).

(4) Buckle the side straps from the bottom of the canister carriers to the spider rings, or girth (fig. 118).

(5) Adjust the above straps so that the canisters are forward and do not interfere with the rider's legs.



FIGURE 115.—Carrier in position.

(6) Buckle the girth strap from the bottom of the muzzlepiece carrier to the girth (fig. 119).

(7) Adjust all straps so that the muzzlepiece carrier rests lightly against the horse's breast in such a way as to allow proper freedom of the shoulders and neck, and so that most of the weight will be suspended from the saddle and consequently very little upon the horse's neck. The strap passing over the neck is a steadying rather than a weight-carrying device.



FIGURE 116.—Snaps attached to pommel rings.



FIGURE 117.—Neck straps fastened.

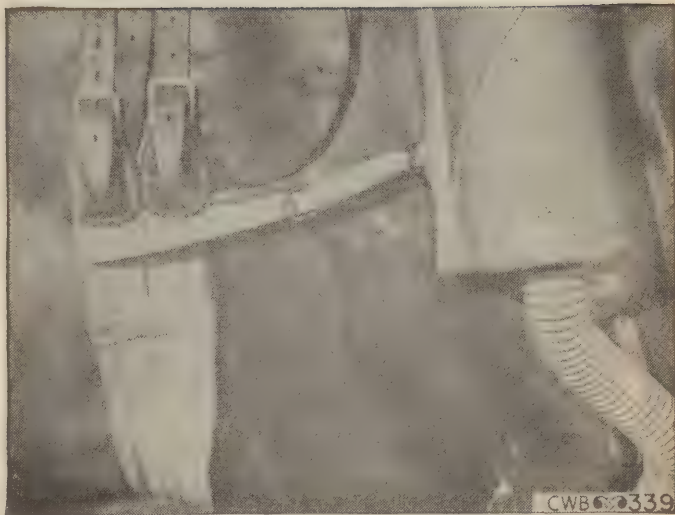


FIGURE 118.—Mask attached to spider rings or girth.

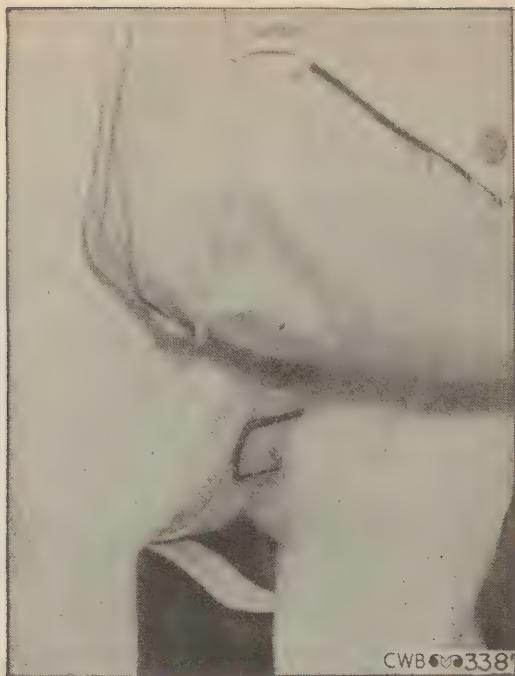


FIGURE 119.—Mask attached to center of girth.

b. Adjustment to the gas position.—Being in the carry position, at the command GAS, the step-by-step sequence given below is followed:

(1) *First.*—(a) Riders or drivers adjust personal masks as prescribed in chapter 5, section II.

(b) If mounted, dismount. If the horse has been feeding, wipe all excess grain or forage from within and around the mouth in order to prevent possible fouling of the outlet valve by particles of feed.

(2) *Second.*—(a) Remove the muzzlepiece from its carrier (fig. 120).



FIGURE 120.—Removing muzzlepiece from carrier.

(b) Make sure the hose is not twisted.

(c) Remove straps from the inside of the muzzlepiece.

(3) Put the muzzlepiece on the horse by grasping the front of the muzzlepiece and the nose band of the halter with the left hand. Insert the fingers of the right hand in the lower part of the aperture, pull with the right hand and stretch the muzzlepiece under the lower jaw (fig. 121). Then, with both hands and standing in front of the horse, push the upper end of the front of the muzzlepiece well up on the animal's face in order that the nostrils will not be restricted.



FIGURE 121.—Adjusting muzzlepiece.

(4) Place the nose band of the halter over the front of the muzzlepiece and pull the lower end of the muzzlepiece up around the lower lip and jaw.

(5) Pass the muzzlepiece straps under the cheek straps of the bridle and fasten the snaps to the halter rings. The length of the strap should be adjusted so that it exerts the minimum amount of tension required to hold the muzzlepiece securely in place.

(6) Attach the hose to the halter by inserting the web strap of the hose fastener over the halter throat strap from front to rear and secure the snap to the ring of the fastener (fig. 122).



FIGURE 122.—Halter and hose straps attached.

(7) Teamsters or hostlers continue with the remainder of the team or group until all are masked. Cannoneers or wagoner's assistants should habitually mask the off horses of teams. If any one horse is frightened or fractious, pass on to the remaining horses, leaving the difficult ones until last.

(8) If originally mounted, mount. If not, stand to horse.

c. To remove mask.—With masks adjusted, and at the halt, the command is: **REMOVE AND REPLACE GAS MASKS.**

(1) *First.*—(a) If mounted, troopers or drivers dismount.

(b) Troopers or drivers test for gas.

(c) Troopers or drivers remove and replace personal masks.

(2) *Second.*—(a) Open horse mask carrier and fold the flap behind it.

(b) Disengage the hose support at the throat strap of the halter.

(c) Unsnap fasteners on the muzzlepiece straps.

(d) Grasp upper end of the muzzlepiece and pull it down over the horse's nose. (Do not pull on the hose attached to the muzzlepiece.)

(e) Place the muzzlepiece straps in the muzzlepiece and fold the muzzlepiece.

(f) Insert the muzzlepiece in the carrier as illustrated in figure 123①.



FIGURE 123.—Replacing muzzlepiece in carrier.

(g) Place the hose in the carrier as shown in figure 123②.

(h) Close the carrier cover and secure the snap fasteners.

(i) Teamsters and hostlers assist with the remaining animals.

(j) If originally mounted, mount.

■ 160. ADJUSTMENT OF HORSE GAS MASK M5.—*a. Adjustment to the carry position.*—This mask should be adjusted to the carry position in a manner similar to that of the M4 gas mask except that the snap of the center pommel strap from the canister cover is engaged in a ring of the pommel ring strap attached to the pommel (fig. 124).

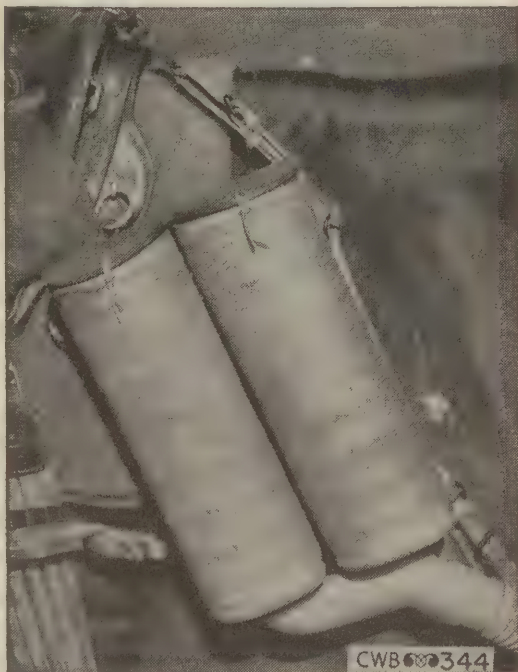


FIGURE 124.—M5 canisters in place.



FIGURE 125.—M5 mask adjusted.

b. Adjustment of horse gas mask M5 to the gas positions.—Same as paragraph 159b (fig. 125).

c. Replacement of muzzlepiece in carrier.—Same as paragraph 159c.

■ 161. INDIVIDUAL INSPECTION.—Horse masks should be inspected frequently. The procedure is as follows:

a. Muzzlepiece.—Examine the muzzlepiece for any holes or cracks. Inspect the inlet and outlet valves. The ferrules of the valves should be inspected for dents or holes.

b. Hose.—Inspect the hose for holes. Flattening which might cause increased breathing resistance should be noted.

c. Canister.—Canister carriers should be inspected to determine if they are damaged or if there is moisture present. Moisture in the canister will increase the resistance of the canister.

d. Harness.—All straps should be inspected for twisted or broken parts. Buckles, snaps, ferrules, and tees should be tested and reported if damaged.

e. Muzzlepiece carrier.—Inspect the carrier for tears or holes. See that no dirt or twigs are in the carrier. Test the snap fasteners for operations.

■ 162. UNIT INSPECTION.—Commanders of mounted organizations equipped with horse masks should inspect such equipment at frequent intervals for cleanliness and serviceability. This inspection should include adjustment of masks on the animals.

a. Procedure.—(1) In preparation for inspection, troop, battery, or company commanders should have the organization take a suitable formation. The commander then cautions "Horse masks will be inspected."

(2) If mounted, troops will dismount and stand to horse. The commander then commands: PREPARE FOR INSPECTION OF HORSE MASKS. At this command troopers or drivers remove the muzzlepiece from their carriers and engage the snap on the off (right) muzzlepiece strap to the near square of the halter at the junction of the nose band and near cheek strap. As the inspecting officer passes along the line each soldier will raise the flap on the muzzlepiece carrier to expose the straps around the hose and turn the muzzlepiece to show all sides as directed by the inspector who visually examines the mask.

(3) Upon completion of visual inspection the commander commands: GAS. Horse masks are adjusted and the inspector observes each horse for adjustment of the mask.

b. Ceremonies.—Organization commanders may include inspection of horse masks at an appropriate time during mounted inspection ceremonies.

■ 163. CARE.—*a. Leather parts.*—The leather parts are cleaned with saddle soap after use and at frequent intervals while in storage, necessary repairs being made by the organization saddler.

b. Rubber parts.—The rubber parts are cleaned after use, or when necessary, with a sponge and water and then dried with a cloth. When they become damaged by age or accident, they must be replaced. Another mask should be used as a guide when making repairs. Rubber cement must be used on ferrules and on the inside of the ends of hose to facilitate their assembly. When an outlet valve is replaced, care must be taken to insert the ferrule into the valve so that the upper end of the valve fits snugly, but not tightly, against the shoulder of the ferrule to prevent the entrance of air. Rubber cement must be used on the outside of the valve and inside of the muzzlepiece opening to facilitate insertion of the valve.

c. Metal parts.—Damaged metal parts such as buckles, snaps, ferrule, or tees must be replaced.

d. Replacement of masks and component parts.—Unit gas officers and organization commanders must arrange for the prompt replacement of unserviceable parts as needed. All men should be trained to report damage to their masks which might cause them to be ineffective in gas attacks. Crushed canisters or canisters which have become wet or have been used in long or high concentrations of gas should be replaced at once. Canisters may be expected to protect against gas attacks one hour daily for about one month.

■ 164. STORAGE.—*a. In warehouses.*—Horse masks are packed for shipment and stored in individual strawboard boxes prior to issue to organizations. The boxes should be stacked in tiers not over 10 boxes high in vermin-proof warehouses maintained at the lowest practicable temperature in order to prolong the serviceable life of the rubber parts.

b. In company supply room.—After issue to organizations, the horse masks must be removed from the packing boxes and stored in the company supply room in such a way that the rubber parts are not distorted. The room must be darkened or the masks covered with dark material to prevent deterioration of the rubber by sunlight. A suggested method of storing the masks in the company supply room is to hang them on pegs fixed to the wall as shown in figures 126 and 127. After a mask is once adjusted to a horse, it is marked with the Preston brand number of the horse and thereafter

used on that animal. The storage space likewise is numbered and the mask kept in its designated place. The Preston brand is impressed by means of rubber stamps and black stamping ink on the front of the left canister carrier of the M4 mask, or near the middle of the strap attached to the near (left) side of the muzzlepiece carrier of the M5 mask.



FIGURE 126.—M4 mask in storage.

c. In the field or in a vehicle for transportation.—When masks are stored in the field or in a vehicle for transportation, they must be protected from water or rain, and heavy objects must not be placed on top of them.

d. In camp at night.—When horses are unsaddled at night and a gas attack is possible, masks may be placed on horses

in the carry position attached to a surcingle. Extra stable guards must be posted to prevent damage to, or displacement of, the masks. In the case of the M5 mask the snap on the right pommel strap and the snap on the left pommel strap will be engaged and the left pommel strap placed over the horse's neck in front of the withers in such a manner that



FIGURE 127.—M5 mask in storage.

the canister carrier is permitted to slip down and hang in the most comfortable position. The carrier is held back by the strap attached to the surcingle. Under such conditions it is assumed that troopers will be sleeping in the immediate vicinity of their horses and available to adjust masks to the gas position. When a gas attack is not expected the masks must be removed and stored on top of the saddles with the

inlet holes of the canisters placed downward to protect them from rain.

SECTION III

USE OF HORSE GAS MASKS

■ 165. MODIFICATION OF MASKS TO FIT INDIVIDUAL ANIMALS.—

The size of the muzzlepiece aperture may be increased and the length of hose decreased to improve the adjustment of masks to animals of various sizes. Such modifications may be made in organizations, but should be resorted to only when absolutely necessary. In such cases the modifications must be supervised by an officer and the amount of alteration standardized insofar as practicable. (See par. 158a(1).) In pack battalions it may be desirable to shorten the hose to improve the adjustment on small pack animals.

■ 166. TRAINING.—*a. General.*—The respiratory system of the horse is very susceptible to injury by gas, and because the animal cannot be trained to hold its breath, practice in quick and rapid adjustment of the mask is very important. The mask is carried in two positions: "carry" and "gas." It can be fully adjusted from the carry to the gas position in approximately 45 seconds. The majority of animals do not object to being masked, and those that show fear at first soon become accustomed to being masked. As the mask is comfortable and harmless, it may be left upon the animal for long periods of time if gas attacks are imminent.

b. Wearing exercises.—(1) Frequent adjustment and wearing exercises should be performed by units equipped with horse masks. These exercises are best conducted in connection with other mounted training and should not be scheduled as gas mask drills alone.

(2) When horses are first ridden with masks adjusted, it will be found advisable in most cases to use a loose rein, as many animals show a tendency to drop behind and even to rear under a tight rein. After a horse has been walked in a mask for a few minutes on a loose rein, this tendency disappears.

(3) Because gas attacks generally occur at night or early morning, it is especially important that all soldiers of

mounted organizations be required to practice adjusting the horse mask during darkness.

c. In theater of operations.—The masks must be carried on horses at all times in the theater of operations, and attendants must be ready to mask the horses immediately. If necessary, the masks may be worn in the gas position for periods of 5 hours.

SECTION IV

PIGEONS

■ 167. PROTECTION.—*a. Effect of chemicals.*—(1) Pigeons are highly susceptible to respiratory irritation. However, the pigeon consumes a relatively small amount of air when caged



FIGURE 128.—Gasproof pigeon carrier.

or in a pigeon loft, and when in the air, nearly always flies high enough above the ground to escape effective gas concentrations.

(2) Possibilities of vesicant action on the skin are small, as the feathers provide much natural protection.

b. Group protection.—Since individual protection for pigeons is impractical, only group protection is provided. This resolves into two practices: first, protection of pigeon lofts and second, protection of pigeons by cages or baskets. In either case the principles are much the same. The loft is protected by sealing all holes to the compartments where the pigeons are kept, except ventilation spaces, which are stopped by means of chemically treated gas proof curtains.

c. Protectors.—The protector consists of a cover of gas-proof fabric adapted to fit over existing Signal Corps pigeon containers. The regular 15-bird container is 30 inches long, 18 inches wide, and 9 inches high, and the 4-bird container 21¼ inches long, 6½ inches wide, and 17 inches high. Each cover is provided with a gasproof zipper closure that extends around three sides of the container. A gas mask hose tube, to which a training canister and a small hand bellows is attached, is fitted over the inlet valve ferrule or over the bottom of the canister when it is desired to force fresh air into the container (fig. 128). Accordingly, only one hose tube canister bellows assembly will be needed for many pigeon protectors. The pigeons should receive fresh air about twice each hour. c

d. Lack of protection.—When for any reason pigeons cannot be protected, they must be released at once.

CHAPTER 8

TRAINING IN DEFENSE AGAINST CHEMICAL ATTACK

	Paragraphs
SECTION I. General	168-169
II. Courses of chemical defense instruction.....	170-175
III. Training methods.....	176-183
IV. Training equipment.....	184-190

SECTION I

GENERAL

■ 168. GAS DISCIPLINE.—*a. Definition.*—(1) For the individual soldier, good gas discipline means that he has a proper respect for the efficiency of gas, but no unreasonable fear of it; that, knowing the value of his protective equipment, he takes care of it; that, upon detection of gas or sound of the alarm, he promptly adjusts his mask and warns others. It implies such training in use of the mask that he is able to wear it for a considerable time and carry on his duties without undue fatigue. It also implies that he does not remove his mask until properly ordered to do so, assuring himself that there is no gas in his immediate locality by testing for gas before removing his mask.

(2) Collectively, good gas discipline implies maintenance of morale under gas conditions. This will insure that there is no panic, but on the contrary, orderly and prompt execution of the prescribed protective procedure.

b. Psychological reaction.—Psychology plays an important part in gas discipline. Most men are filled with fear before they come in contact with a chemical agent. Proper training in defense against chemical attack will eliminate this. It should be impressed upon men that the Army gas mask, properly used, gives 100 percent protection for the eyes and lungs, and that protective clothing gives ample protection against vesicants. Men should be trained to look upon chemical agents as upon any other weapon of war, and understand

that when they make intelligent use of the protective equipment given them, they can encounter chemical attacks with few casualties.

■ 169. PHASES OF TRAINING.—Training in defense against chemical attack is progressive as is all other training in the Army. It begins with the school phase for the training of specialists and instructors, progresses to the unit training phase for the training of all unit personnel in the fundamentals of defense against chemical attack, and concludes with the field training phase in which gas situations are introduced into field exercises and maneuvers.

a. School phase.—This phase consists of classroom instruction to train unit gas officers and noncommissioned officers, and to insure the availability of competent instructors for troops. Such training is usually accomplished through a course in defense against chemical attack at each post, camp, and station. The instructor is normally the corps or division chemical officer. However, full use should be made of other officers who are graduates of the Chemical Warfare School. In some instances, notably in foreign departments where stations are not far apart, it is desirable to order the students to a central point for the course, particularly when extra facilities such as a chemical company with its allowance of munitions is available at a particular station. After the course, provision is made in the normal garrison school for the training of company noncommissioned officers and any company officers who may require instruction to enable them to train their units. In order to acquire the uniformity necessary for operations, the unit gas officers and noncommissioned officers are normally assembled and trained under the personal supervision of the division chemical officer. These trained specialists in turn instruct and assist the troop officers in training their units.

b. Unit training phase.—This phase consists of the practical training of organizations in chemical defense, such as fitting the gas mask, gas mask drill, passing through the gas chamber, masking animals (mounted units), accustoming men and animals to pass through gas and smoke in the field, marching, drilling, driving motor vehicles, operating signal communication, and firing weapons with gas masks ad-

justed, first aid, identification of agents, the construction and maintenance of gasproof shelters, and the decontamination of areas and equipment. In brief, it consists of completely practical instruction in the unit with a view to minimizing casualties and preventing undue interruption to normal military action in combat during a gas attack.

c. Field training phase.—This phase consists of introducing into normal tactical field exercises of the battalions and higher units those chemical warfare features which will require the unit gas officers and gas noncommissioned officers to function in their respective positions. In this training, unit commanders will make decisions relative to defensive features, and all ranks will operate while wearing the gas mask in tear gas and smoke. Care must be taken to avoid emphasizing unduly the chemical warfare features of the exercise to the extent of making them illogical or tactically unsound. So far as practicable, situations involving defense against chemical attack should be made a part of tactical exercises normal to the field training of units rather than formulating special problems for the particular purpose of illustrating defense against chemical attack.

SECTION II

COURSES OF CHEMICAL DEFENSE INSTRUCTION

■ 170. GENERAL.—*a.* Courses of instruction are suited to the time allotted. In a short course only fundamental ideas can be presented, while in a longer course, more subjects may be included.

b. FM 21-5 should be thoroughly studied and the methods advocated therein used to their full extent. The officer should have a clear idea of the mechanism of instruction, the preparation of programs and schedules, and the formulation of lesson plans.

■ 171. UNIT GAS OFFICERS' COURSE.—*a. Objective.*—The object of this course is to give instruction to unit gas officers so that they will qualify to perform their duties.

b. Subjects and time.—The program outlined below is offered only as a general guide for a course of instruction of unit gas officers. It covers a wide range of subject matter and

gives a suggested number of hours for each subject. The time devoted to each must be varied to meet local conditions. The general classification of subjects is as follows:

(1) <i>Agents</i> .—Properties; application of elementary chemistry and physics; identification.....	9 hours
(2) <i>General subjects</i> .—Course orientation; course summations; current applications; examination....	4 hours
(3) <i>Matériel</i> .—Chemical weapons, munitions, technique of releasing agents.....	6 hours
(4) <i>Operations</i> .—Chemical service units; terrain appreciation; tactical employment; field exercises..	8 hours
(5) <i>Protection</i> .—Individual and collective; gas mask drill, inspection, and repair; physiological effects of combat gases and smokes; first aid; decontamination materials and methods.....	22 hours
(6) <i>Training</i> .—Materials; methods; application exercises; conduct of unit training.....	8 hours
(7) <i>Weather</i> .—Meteorological fundamentals; forecasting; effect upon agents.....	3 hours
Total.....	60 hours

■ 172. GAS NONCOMMISSIONED OFFICERS' COURSE.—*a. Objective*.—The object of this course is not only to train gas non-commissioned officers to be proficient as individuals in defense against chemical attack, but also to instruct them in training methods so that they will be able to train others.

<i>b. Subjects and time</i> .—(1) <i>Agents</i> .—Properties and identification.....	3 hours
(2) <i>General subjects</i> .—Course orientation; examination.....	3 hours
(3) <i>Matériel</i> .—Principal methods of dispersing agents.....	2 hours
(4) <i>Operations</i> .—Terrain appreciation; field exercise.....	1 hour
(5) <i>Protection</i> .—Individual and collective; first aid; decontamination.....	9 hours
(6) <i>Training</i> .—Methods.....	1 hour
(7) <i>Weather</i> .—Influence upon agents; conditions favoring chemical attack.....	1 hour
Total.....	20 hours

■ 173. BASIC SOLDIER COURSE (REPLACEMENT TRAINING CENTER).—*a. Objective.*—The object of this course is to teach the basic soldier the fundamentals of protection afforded by the gas mask and its inspection and care.

b. Subjects and time.

(1) Chemical warfare orientation.....	20 minutes
(2) Agents	120 minutes
(3) Nomenclature of the mask.....	20 minutes
(4) Disinfection of masks.....	10 minutes
(5) Gas mask drill.....	120 minutes
(6) Training films	50 minutes
(7) Inspection and care of masks.....	20 minutes
(8) Gas chamber test	60 minutes
Total.....	7 hours

■ 174. INTERMEDIATE SOLDIER COURSE.—*a. Objective.*—The object of this course is to train the soldier so that he will attain the proficiency in defense against chemical attack outlined in paragraph 4.

b. Subjects and time.

(1) <i>Agents.</i> —Recognition; first aid.....	1½ hours
(2) <i>General subjects.</i> —Foreign development in chemical warfare.....	½ hour
(3) <i>Matériel.</i> —Weapons and munitions likely to be used.....	1 hour
(4) <i>Operations.</i> —Types of attack, signs of at- tack.....	1 hour
(5) <i>Protection.</i> —Gas mask; protective clothing; gasproof shelters; decontamination; gas cham- ber.....	4½ hours
(6) <i>Training.</i> —Duties of gas sentinels.....	1 hour
(7) <i>Weather.</i> —Conditions favoring gas.....	1½ hours
Total.....	11 hours

■ 175. ORGANIZATIONAL COLLECTIVE PROTECTIVE TRAINING.—*a. Objective.*—The object of this course is to instruct the command as a whole in all measures which will minimize casualties and prevent undue interruption to normal military action during combat in the presence of gas.

b. Subjects.—The following list contains subjects that should be taught. No suggested time is indicated as this will depend upon the type of command.

(1) Standing operating procedures for defense against chemical attack.

(2) Chemical reconnaissance and intelligence.

(3) Disposition of troops to meet an attack.

(4) Protection against chemical attack from the air.

(5) Protection during movements into combat.

(6) Protection during combat.

(7) Measures taken after a chemical attack.

SECTION III

TRAINING METHODS

■ 176. **GENERAL.**—Methods used in training for defense against chemical attack differ only slightly from prescribed methods for other types of training. The usual methods, that is, lectures, conferences, demonstrations, group performance, and coach-and-pupil, as outlined in FM 21-5, apply equally as well to chemical warfare training. Whether instruction is given indoors or out, it is essential that all men be able to see and hear it. A small ravine or even sloping ground makes an acceptable amphitheater for staging a demonstration with students placed above the instructor. The instructor should face his audience and make certain his voice carries clearly to the farthest member of the group. The sun should always be behind the students and the area so selected that no distractions occur during the instruction.

■ 177. **GAS MASK DRILL.**—When conducting gas mask drill the instructor and his assistant should be elevated and in front of the class. The formation shown in figure 129 is ideal for instruction of this kind. Students should be in not more than three rows, with sufficient space between men for necessary drill action, and files staggered so that all may see the assistant's demonstration. Noncommissioned officers should be placed in front of the group to check the instruction. The instructor and noncommissioned officers do not put on their masks. The assistant should go through each movement slowly and precisely so that the instructor is free to explain



FIGURE 129.—Gas mask drill instruction formation.

CWB 600 350

each step of the drill. In all gas mask drills, emphasis will be placed upon precision rather than speed.

■ 178. TRAINING FILMS AND FILM STRIPS.—Training films and film strips are among the most valuable and most modern aids to instruction. Their use should be a planned part of any instruction course. However, they should never be used as a substitute or a sole means of instruction. The Chemical Warfare Service visual aids have been deliberately planned and produced with a view to making both film strips and training films interdependent within a narrow subject. Current Chemical Warfare Service film strips and training films are listed in FM 21-6. They are obtained by following the procedures outlined in AR 105-260.

■ 179. PRACTICAL EXAMINATION IN GAS MASK FITTING AND ADJUSTMENT.—The gas chamber exercise is the final test in determining the soldier's ability to adjust his mask in gas, and is an absolute test of the fit of the mask. In addition, surprise attacks of tear gas, while in the field, will furnish an index to the thoroughness of training.

■ 180. EXAMINATION IN AGENTS.—Two examinations may be given to determine the ability of men to identify the various agents. The use of covered and numbered sniff bottles will furnish one check. A much more realistic test consists of the identification of agents in the field by means of the set, gas identification, detonation, as described in paragraph 8b.

■ 181. PERIODIC UNIT INSPECTIONS.—Unit inspections of all protective equipment should be made periodically. These may be formal or held informally at irregular intervals. Surprise release of tear gas and the consequent adjustment of masks can also be considered as an inspection device. When personnel are in action, gas mask inspections should be made daily. In training they should be held at least once each week. These inspections should cover not only a physical examination of the mask, but also provide a check upon the individual's ability to adjust it and perform the other phases of the gas mask drill.

■ 182. TRAINING INSPECTIONS.—*a. Test of individuals in mask adjustment.*—In addition to the individual tests mentioned

in paragraph 180, officers should make frequent tests of men when on field exercises or when engaged in other activities requiring masks as part of the equipment. Individuals are selected separately and at random and put through the phases of gas mask drill. In this fashion a cross-section is obtained on the proficiency of training.

b. Tests in unit protection plans.—Preparation of standing operating procedures (S. O. P.) is required of all chemical officers. However, the real benefit of these provisions cannot be determined unless tests are applied frequently to check upon the response of organizations.

(1) *Scheduled tests.*—Company commanders and personnel should be warned that a test will be held at a specified hour. The officer in charge prepares a check list upon which he may judge the efficiency of the company in performing the necessary functions. In this list he should include such items as:

- (a) Are gas sentinels properly placed?
- (b) Are they provided with proper equipment?
- (c) Do they attend to their duties properly?
- (d) Do men adjust their masks promptly and accurately?
- (e) Do personnel take advantage of available cover?
- (f) Do the men take the exercise seriously?
- (g) Are the actions of officers commendatory?
- (h) Are the proper procedures followed after the period of attack?
- (i) Are individuals indicated as casualties properly treated?
- (j) Are contaminated areas properly posted?
- (k) Are contaminated areas avoided by personnel?
- (l) Does questioning show that gas sentinels and personnel have a clear understanding of their orders?
- (m) Are personnel familiar with the gas alarms?
- (n) Do personnel remain masked until ordered to unmask?
- (o) How many men violate the rules of gas discipline?
- (p) If the problem requires, is proper chemical reconnaissance made?
- (q) If required, are contaminated areas promptly vacated in an orderly fashion?
- (r) Is decontaminating equipment adequate and available?
- (s) If required, are areas promptly and efficiently decontaminated?

(t) Do unit gas noncommissioned officers perform their duties efficiently?

(2) *Unscheduled tests.*—After two or three such tests as indicated in (1) above, unscheduled tests will be held and a check list applied. Companies should be graded and the grades published as an incentive for competition and exactness. A company is the largest unit that can satisfactorily be scored, although smaller units may be tested, if desired.

■ 183. RECORDS.—*a. Recruit and replacement center.*—A record should be kept showing the progress of each enlisted man in the various stages of chemical warfare training. This may be combined with the progress record showing his other training activities, and should be kept up to date and included in the man's service record when he is assigned to a new station or organization. A sample record form is shown in appendix IV.

b. Company and training.—Essentially the same type of record may be used for the advanced training of personnel. This will indicate the attainments of the individual in chemical warfare training. In addition, a company progress chart should be prepared which will give a record of the collective protection training.

SECTION IV

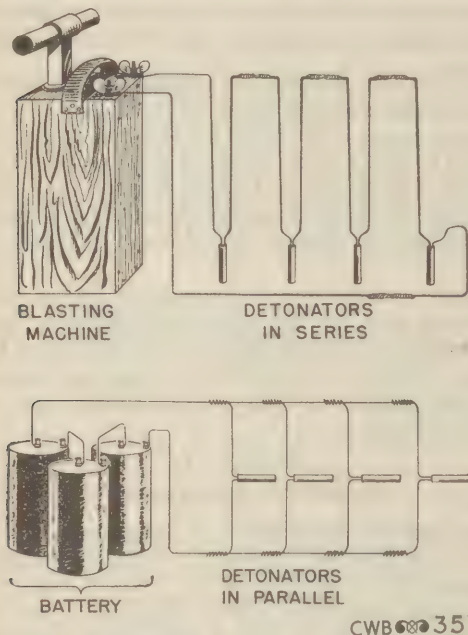
TRAINING EQUIPMENT

■ 184. GAS IDENTIFICATION SETS.—*a. Sniff set.*—The description and use of this set is given in detail in paragraph 8a. It is best suited for small groups.

b. Detonation set.—This set is thoroughly described in paragraph 8b. Groups of various sizes up to a company can participate in this test.

■ 185. BATTERY OR BLASTING MACHINE.—*a. Electrical ignition.*—For firing the detonators on the gas identification set or on land mines, as well as igniting the charge of a Livens projector, an electric current is necessary. This may be furnished by a battery or by a blasting machine (exploder box). Two or three dry cells may be connected in series to form the battery, or an automobile type storage battery may be used. With a battery the detonators should be connected in parallel (fig. 130).

b. Blasting machine.—A blasting machine is used to generate current for electric firing. It is of the plunger type, usually with a capacity of 100 caps. Types are also available in 10- and 30-cap capacity. With a blasting machine the detonators should be wired in series (fig. 130).



CWB 351

FIGURE 130.—Wiring diagram to fire detonators.

(1) *Operation.*—For operation, the blasting machine is set squarely upon a solid, level surface, the lead wires connected, the rack bar withdrawn by the handle to its full extent, and with a quick, hard stroke, pushed down forcibly to the bottom of the box using both hands. The circuit is closed at the end of the stroke.

(2) *Care.*—Blasting machines should be stored in a dry place. They should not be thrown about carelessly nor exposed to wet weather.

(3) *Test.*—A blasting machine may be tested by connecting to it in series the proper number of squibs and pushing down the rack bar forcibly. This method is expensive and the procedure with a rheostat will obtain the same results. To test the blasting machine with a rheostat, only two squibs are used (fig. 131). One wire of each squib is connected to



FIGURE 131.—Method of testing blasting machine.

the blasting machine and the remaining two wires to the binding posts of the rheostat indicating the number of squibs or detonators desired to be fired. If both fire when the blasting machine is operated, it indicates that the machine is up to capacity. For a more complete description of the blasting machine and its accessories, see FM 5-25 or TM 3-315.

■ 186. **PROJECTION MACHINES.**—*a. Motion picture projectors.*—Motion picture projectors equipped for sound should be used. If a permanent installation is contemplated, it is probable that 35-mm equipment will be furnished. However, if portability is desirable, 16-mm projectors are necessary. Under no circumstances should sound film be run on a projector designed for silent films. The sprocket teeth will destroy the sound track. Silent film, however, may be run on a sound projector without damage.

b. Film strip projectors.—(1) *Silent.*—Projectors for showing film strips are easily portable and may be used even in semidarkened rooms where small groups are assembled. A flat wall, a sheet, or even an erased blackboard may be used as a substitute screen.

(2) *Sound.*—Film strips may be exhibited in connection with records describing each frame. A bell indicates change of frames.

c. Slide projectors.—Slide projectors have been used, although the Chemical Warfare Service has substituted film strips for its slide library. If 2-inch color slides are prepared locally on chemical warfare subjects, their natural color will add to the realism of the subject. Many film strip projectors are equipped to show these slides.

■ 187. **CHARTS.**—Colored charts have been prepared by the Chemical Warfare Service. They are supported on a steel stand. The subjects covered by these drawings are—

Gas mask canister.

Gas mask in carrier and passage of air through the gas mask.

Typical arrangement for gasproofing dugouts.

4.2-in. chemical mortar.

4.2-in. chemical mortar shell.

Portable chemical cylinder.

DM irritant candle.

HC smoke pot.

Livens projector components.

Livens projector accessories.

Livens projector shell.

75-mm chemical shell.

155-mm howitzer chemical shell.

Wing tank for airplane.

30-lb. chemical bomb.

Tactical classification of chemical agents.

■ 188. INERT AND SECTIONALIZED EXHIBITS AND SAMPLES.—Sectionalized shells and other munitions are excellent instructional aids. These should be used for demonstration by the instructor and then closely examined by the student. They may be made from actual munitions such as chemical grenades and smoke pots, care being taken to remove the fuze and the active agents. The active agents should be replaced with plaster of paris. However, a few sectionalized specimens are available from the Chemical Warfare Service. Larger items furnished from this source are—

Livens projector shell, sectionalized.

WP smoke shell, 4.2-in. chemical mortar, sectionalized.

A damaged gas mask, after being properly accounted for, may be sectionalized and made to serve as an excellent teaching aid.

■ 189. MISCELLANEOUS TRAINING MUNITIONS.—*a. Smoke pots.*—Smoke pots may be used to generate a simulated gas attack. For prescribed allowances, see AR 775-10.

b. Tear gas pots.—Tear gas pots furnish a means of generating a large cloud of tear gas for a period of several minutes. They are suited for large scale training missions.

c. Simulated chemical land mines.—For training purposes land mines may be filled with a number of different solutions to simulate mustard gas.

(1) *Butyric acid solution.*—A mixture of 2 percent butyric acid (for odor) with $\frac{1}{2}$ percent calcimine violet (for color) in water makes a cheap and suitable substitute for mustard gas. It is harmless and the color may be removed easily by washing.

(2) *Pyridine in crude oil.*—An excellent mixture for filling chemical land mines is 50 percent pyridine (for odor) and 50 percent crude oil. Waste lubricating oil can be used in place of crude oil. This mixture has a very strong odor that persists for about 2 hours and the liquid is readily seen on terrain. It is rather difficult to remove from clothing. Fatigue clothes should certainly be worn when this is employed in a field problem.

(3) *Crude oil and ammonium valerate*.—Crude oil or waste lubricating oil with 1 percent ammonium valerate (for odor) is an excellent substitute for mustard gas. The odor is very persistent and the oil easily distinguished on the terrain. It is difficult to remove from clothes, and fatigue clothing is necessary.

(4) *Molasses residuum*.—This simulated agent is 25 percent molasses residuum in water. It has a characteristic molasses odor which persists for about 1 hour. The liquid can readily be detected on the ground and surrounding vegetation.

(5) *Asbestine suspension*.—This mustard gas substitute consists of 1 pound of finely ground magnesium silicate added to 2.5 gallons of water. Butyric acid is added for odor. It leaves a white residue which is readily recognized on the terrain.

d. Instructional incendiary bombs.—Two types of instructional incendiary bombs are used to demonstrate the burning action of small magnesium and thermit incendiaries. They are useful in training personnel in the correct methods of combating these types of incendiaries. Ignition of these instructional bombs is obtained by means of a pull-wire fuze-lighter. Following ignition, the magnesium M1 instructional bomb burns for 5 minutes; the M2 instructional bomb for 75 seconds.

■ 190. IMPROVISED SUPPLIES AND EQUIPMENT.—*a. Liquid mustard substitute in decontamination exercises*.—Ethylene glycol (Prestone) may be poured in a simulated shell hole. When chlorinated lime (undiluted with earth) is added, much heat is generated which may even cause a flame. This will simulate the action of raw chloride of lime on liquid mustard gas.

b. Improvised gas chamber generators.—Occasionally CN capsules are not available for gas chamber exercises. A few ounces of essence of peppermint or formaldehyde heated and evaporated in the chamber will produce gases that are quite satisfactory for testing masks. Tear gas may be used in hand-spray dispensers by dissolving the solid CN in 180 proof grain alcohol. This can be sprayed in areas through which troops will pass.

c. *Substitute HE land mines.*—When land mines are desired for use with motor vehicles or tanks, a satisfactory practice mine may be made by taking a cylindrical waterproof cardboard container, placing in it a 4-ounce bottle of titanium tetrachloride (FM), and then pouring water around it to a point near the top of the bottle. Rocks of suitable size are put in the water around the bottle. When the tank runs over the mine, the rocks break the bottle, releasing the FM, which reacts with water to form a dense white smoke. If FM is not available, a similar mine may be made by filling the bottle with FS. The water is omitted.

d. *Simulated airplane smoke screens.*—To simulate airplane smoke screens, HC smoke pots may be used in mobile operations by putting them into small wheeled carriers or mounting them in racks attached to the rear of a motor vehicle.

e. *Simulated gas attacks.*—To simulate cylinder gas attacks in the field, a quantity of brimstone or roll sulfur may be burned, the fumes of which will be carried by the wind. The odor is distinctive and masking should result.

APPENDIX I REQUIREMENTS FOR GASPROOF SHELTER

Type of shelter	Capacity	Summer				Winter			
		Ventilated		Unventilated		Ventilated		Unventilated	
		Cubic feet, space	Air supply, cu. ft./min. per person	Space *(cubic feet per person)		Cubic feet, space	Cu. ft. per min. per person	Space *(cubic feet per person)	
				Totally at rest	Normal desk work			Totally at rest	Normal desk work
Underground (walls of high heat conductivity).	10	110	2.75	240	500	80	2.0	200	360
	25	150	4	360	725	125	3.0	300	540
	50	225	5.5	500	1,000	175	4.0	400	750
Underground (walls of low heat conductivity).	10	150	3.6	320	650	105	2.5	250	450
	25	250	5.7	500	1,000	170	4.0	400	750
	50	300	7.5	675	1,350	200	5.5	550	1,000
Above ground (walls of high heat conductivity).	10	80	2	180	360	60	1.5	150	270
	25	110	3	270	540	95	2.35	235	425
	50	170	4	380	720	130	3.0	300	540
Above ground (walls of low heat conductivity).	10	110	2.75	240	500	80	2.0	200	360
	25	150	4	360	720	125	3.0	300	540
	50	225	5.5	500	1,000	175	4.0	400	720

*Based on occupancy 3 hours time.

APPENDIX II EFFECT OF WEATHER AND TERRAIN ON CHEMICAL AGENTS

Agent	Factors	Favorable	Average	Unfavorable
Smokes.....	Terrain characteristics.....	Level fields or water	Moderately rolling farm lands	Broken or wooded
	Wind velocity (mph).....	Steady 3-8	Slightly shifting 8-12	Variable-gusty over 12
	Sky	Heavy overcast	Partly overcast	Clear
	Ground temperature.....	Colder than air	Same temperature as air	Warmer than air
	Time of day.....	Night or early morning	Midmorning, late afternoon	11 A.M. to 4 P.M.
	Humidity	High	Moderate	Low
	Precipitation	Fog or mist	None	Heavy rain
Gases.....	Terrain characteristics.....	Wooded broken	Moderately rolling farm lands	Level fields water
	Wind velocity (mph).....	Steady 0-4	Slightly shifting 4-9	Variable-gusty over 9
	Sky	Heavy overcast	Partly overcast	Clear
	Ground temperature *	Colder than air	Same temperature as air	Warmer than air
	Time of day.....	Night or early morning	Midmorning, late afternoon	11 A.M. to 4 P.M.
	Humidity	Low	Moderate	High
	Precipitation.....	None.....	Light rain.....	Heavy rain

* HS is not effective below 32° F.

APPENDIX III

SAMPLE STANDING OPERATING PROCEDURE

HEADQUARTERS _____ DIVISION

A. P. O. # _____

Fort _____, _____

GENERAL ORDERS

No. ----- }

STANDING OPERATING PROCEDURE

FOR

DEFENSE AGAINST CHEMICAL ATTACK

■ 1. **GENERAL.**—*a. References.*—Defense against chemical attack will be governed in general by the principles contained in Field Manual 21-40 and such additional instruction as contained herein.

b. Responsibility.—Unit commanders are responsible for the state of gas discipline, and for the provision, use, and maintenance of protective equipment.

■ 2. **PROCEDURE PRIOR TO CHEMICAL ATTACK.**—*a. Unit organization.*—Each regiment and battalion will have designated at all times one unit gas officer and one gas noncommissioned officer as assistant. Each company will have designated two unit gas noncommissioned officers. All men will be so trained that decontaminating parties may be selected in the field at any time from available personnel.

b. Gas sentinels.—In addition to their normal duties, all sentinels, including military police, will function as gas sentinels. Special gas sentinels will be equipped with percussion type gas alarms and posted at all times, well up wind over sleeping men, working parties, at ammunition dumps, food dumps, gasproof shelters, command posts, and first-aid stations. Close attention will be given to weather conditions favorable to gas attack, especially wind direction.

c. Protection from aerial chemical attack.—Security from aerial chemical attack requires immediate adjustment of the gas mask and other protective equipment at the beginning of any attack from low-flying airplanes.

d. Use of protective equipment.—Personnel are individually responsible for having their gas masks and protective equipment available at all times. Protective covers or paulins will be kept in place on food, water containers, instruments, guns, ammunition, and other equipment when not in use or operation. In cooking areas in bivouac, tarpaulins or other protective cover must be provided both overhead and to windward to reduce the danger of food being subjected to chemical spray.

■ 3. PROCEDURE DURING AND AFTER CHEMICAL ATTACK.—*a. Reconnaissance.*—Immediately after a gas attack, unit gas officers or gas noncommissioned officers will carry out a reconnaissance to determine the limits of the contaminated area and the intensity of the contamination. Advance unit gas reconnaissance parties will include sufficient personnel and material for limited decontamination of roads, bridges, and so forth. Reports regarding gassed areas will be submitted as in *d* below.

b. Weapons, food, and water.—Weapons exposed to gas will be decontaminated by the users as soon as the attack is over. Rags, after use, will be burned. Food and water that have been exposed, or suspected of having been exposed to gas or WP particles, will not be used for any purpose until authority has been granted.

c. Contaminated areas.—Areas contaminated with vesicant chemical agents will normally be avoided. When it is necessary to traverse such areas, personnel will mask and proceed rapidly and carefully.

d. Reports.—In the event of a gas attack or discovery of a contaminated area, a report will be made to the division commander at once by the most expeditious route. Such reports will include the date, time, place, type of agent, type of weapon, and an estimate of the size of the attack. If a new chemical substance is suspected, a sample of the chemical agent, munition, or contaminated material will accompany the report.

e. Violations of orders.—Individual violations of above orders, and of instructions contained in FM 21-40, will be reported to respective commanders for disciplinary action.

APPENDIX IV

SUGGESTED CHEMICAL WARFARE SUBJECTS FOR EFFICIENCY REPORT (ENLISTED REPLACEMENT TRAINING CENTER)

Motor mechanic Communication
Chauffeur and staff
Baker and cook Clerk and typist
 Line soldier

1. Entered
 (Date)
Departed
 (Date)

Rating

2. *Basic and General*

Nomenclature of the mask
Gas mask drill
Care and disinfection of the
mask
Gas chamber exercise

3. *Technical Training*

Recognition of chemical
agents
First aid for chemical casu-
alties
CW weapons and muni-
tions
Signs of chemical attack
Protective clothing
Collective protection
Decontamination
Duties of gas sentinels
Weather and terrain

These and other basic and intermediate soldier subjects should be placed on one side of the page. On the other side of the page appears the heading and the recommendations of platoon and company commanders. The material for the back of the page is shown below:

Noncommissioned
Officers' material Yes or No
Acting sergeant since
Acting corporal since
Completed two weeks actual
training: Reason
Platoon or Co. Commander
remarks:

Ratings are to be entered as
follows:

Sup—Superior
E—Excellent
S—Satisfactory
U—Unsatisfactory
I—Inferior

N—No training received.

An entry should be made under
each heading.

This sheet will be folded in the center and attached to the service
record.

Fort Custer
Enlisted Replacement Training
Center
Battle Creek, Michigan
EFFICIENCY REPORT
(File with service record)
Name
A. S. N.
Org.

APPENDIX V

LIST OF REFERENCES

1. FIELD MANUALS.

Tactics of Chemical Warfare.....	FM 3-5
Supply and Field Service.....	FM 3-15
Employment of Chemical Troops.....	FM 3-20
Military Training.....	FM 21-5
List of Publications for Training, Including Training Films and Film Strips.....	FM 21-6
Soldier's Handbook.....	FM 21-100
Field Service Regulations—Operations.....	FM 100-5
Administration.....	FM 100-10
Staff Officers Field Manual—Staff and Combat Orders..	FM 101-5
Organization, Technical and Logistical Data.....	FM 101-10

2. TECHNICAL MANUALS.

The Gas Mask.....	TM 3-205
Military Chemistry and Chemical Agents.....	TM 3-215
Meteorology.....	TM 3-240
Use of Smokes and Lacrimators in Training.....	TM 3-305
Treatment of Casualties from Chemical Agents.....	TM 8-285

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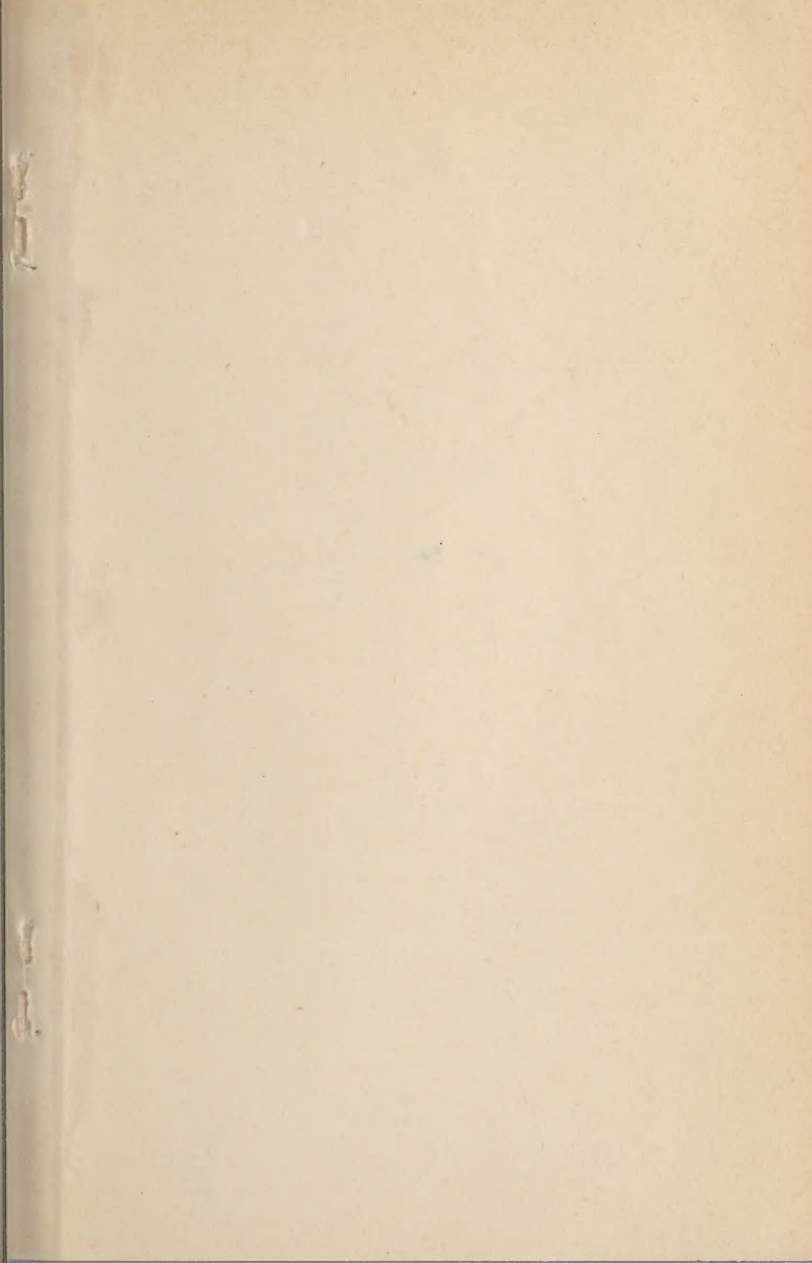
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